農業研究

第十卷　第二期

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GENIC ANALYSIS IN RICE

II. Inheritance of Resistance of Rice Seedlings to Blast Disease, *Piricularia Oryzae*(1)

by

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The blast disease caused by *Piricularia Oryzae* is the most important in the most rice growing countries. It seriously damages rice when nitrogen fertilizer is heavily applied. Therefore, breeding for blast disease resistance is urgently needed and a number of promising resistant varieties have been selected in various countries. However, the knowledges on the genetics of disease resistance are still limited.

In order to get more knowledge on the genetics of blast disease resistance in rice, the writers have conducted genetic experiment of leaf blast resistance in seedlings of rice. The preliminary results obtained through artificial inoculation are reported in this paper.

MATERIALS AND METHOD

Six resistant, six intermediate and seven susceptible varieties from Japan, U. S. A. and Taiwan were used as cross parents. 15 F_2 crosses together with their parental strains were planted in a specially designated green-house, in where artificial inoculation of blast fungus onto the seedlings was made.

Table 1. Strains used for genetic studies of blast disease resistance.

Strain No.	Variety name	Origin	Type of leaf blast resistance
P 123	Taichung No. 65	Taiwan (Ponlai)	Susceptible
P 124	Taichung No. 150	Taiwan (Ponlai)	Susceptible
P 130	Taichung No. 130	Taiwan (Ponlai)	Intermediate
P 138	Taichung No. 46	Taiwan (Ponlai)	Susceptible
P 141	Chianan No. 2	Taiwan (Ponlai)	Susceptible
P 163	Nung-yu g. No. 8	Taiwan (Glutinous)	Susceptible
P 167	Pai-kan-tao	Taiwan (Ponlai)	Resistant
T 208	Wu-liap--chin-yu	Taiwan (Native)	Resistant
T 215	Wu-liap	Taiwan (Native)	Resistant

(1) The expensess of this experiment were financed by a grant of the Rockefeller Foundation, RF 59029, "Studies on the causes of low yield of rice in tropical and subtropical regions." The writers wish to express their hearty thanks to the generous grant. Thanks are due to Dr. H. I. Oka of National Genetics Institute of Japan for a reading of the manuscript.

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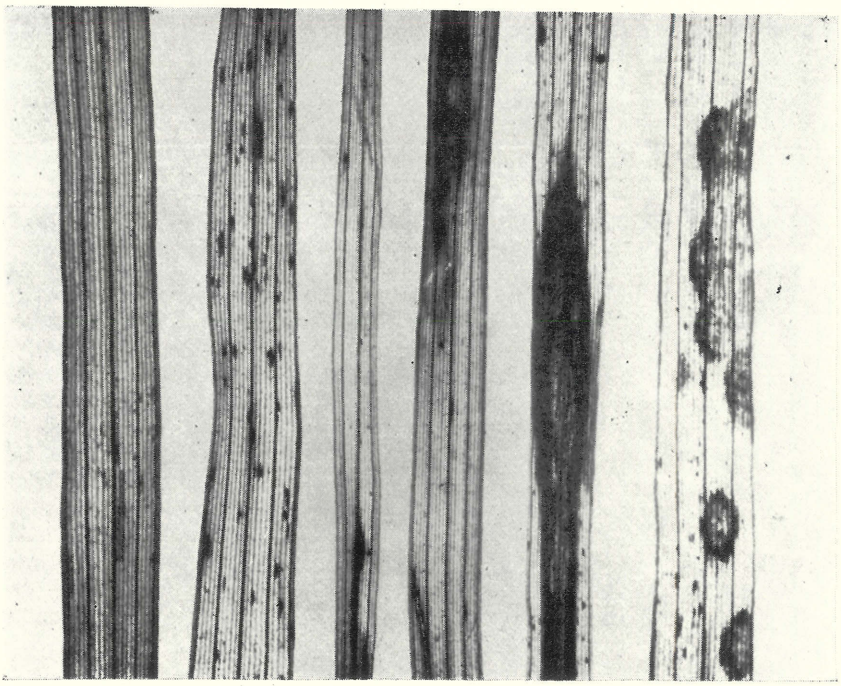
T 234	Wu-kao	Taiwan (Native)	Intermediate
J 302	Nakamura	Japan (Japonica)	Susceptible
M 503	Siau-nan-sien	China mainland	Intermediate
A 73	Nagao's gene marker	Japan	Susceptible
7101	Jodon's gene marker	U. S. A.	Intermediate
7114	Jodon's gene marker	U. S. A.	Resistant
7245	Jodon's gene marker	U. S. A.	Resistant
7247	Jodon's gene marker	U. S. A.	Resistant
9781	Jodon's gene marker	U. S. A.	Intermediate
9783	Jodon's gene marker	U. S. A.	Intermediate

The inoculum was composed of a number of isolates taken from infected leaves collected from various parts of Taiwan. Single conidia from single lesion was cultured in artificial media and the inoculum was applied in the form of a conidial suspension. The rice seedlings were grown in fungus free soil in iron flats (30 cm×30cm in size), placed in the green house. About 40–50 seedlings are planted in separated blocks in the same flat. Prior to the inoculation, 2% ammonium sulfate solution was top-dressed to the flats twice, at the rate of 25 cc per flat for each application. When the seedlings reach at the height of 15 cm, the conidial suspension was sprayed onto the leaves of seedlings. The inoculation was repeated 3–4 times so as to minimize the chance of escaping from infection. The flats were then placed in an inoculation chamber where the moisture (80–90%) and temperature (25–28°C) were controlled. A week after inoculation, the flats were moved out of the inoculation chamber into either a wire cage or in a green house, depending on the air temperature outside. Three to four days later, the inoculated seedlings were examined and records with regard to the type of disease lesions were taken according to the following six grades.

Grade	Degree of resistance	Lesion type	Description
O	HR	Immums	No visible sign of infection
A	R	Brown spot	Small brownish-dark brown lesions or spots.
B	MR	Brown margin	Brownish lesions with a distinct border, which would not increase in size.
C	MS	Grayish white center	Slowly expanding lesions restricted in size.
D	S	Large lesions with dark green center	Large lesions surrounded by brownish bands, expanding.
E	HS	Large lesions with grayish center	Water soacked appearance, often without well defined border, variable in size, lesions are expanded drastically.

Note: HR....Highly resistant R.....Resistant.
MR....Moderately resistant. MS....Moderately susceptible.
S......Susceptible. HS....Highly susceptible



O A B C D E

Fig. 1. Six infection types of leaf blast disease.

Figure 1 shows typical types of disease lesions. O, A, and D types were considered as resistant, while C, D and E types were considered as susceptible. The occurrence of blast infection of inoculated seedlings was satisfactory. It was however inevitable that, in some cases, classification was more or less arbitray, since the infection types in certain seedlings were hardly discernible.

EXPERIMENTAL RESULTS

Variation in seedling reaction to blast disease of parental strains and F_2s, obtained in accordance with the above mentioned classes are shown in Table 2.

As the table shows, crosses between resistant and susceptible strains, the F_2 segregated into 3 resistant and 1 susceptible plants in majority of the crosses, showing the resistance to be controlled by a single dominant gene. This result agrees with what Sasaki (1922) and Oka (1957) reported.

In the cross between a susceptible variety J302 (Nakamura, Japonica type) and a resistant variety T234 (Wukao, Indica type), the susceptible plant being smaller and the chi-square value did not show good fits to the expected 3:1 ratio. Since seed fertility in F_1 plant of this cross is 20%, gametic selection due to hybrid sterility may be one of the disturbing factors for such a large chi-square value. It is also possible that the excessive plants may also be due to "disease escaping". However, further studies are necessary for confirmation.

Table 2. Variations in seedling resistance to leaf blast disease in parental lines and F_2s in green-house experiment.

Year	Parents and crosses	O	A	B	C	D	E	Resistant (O+A+B)	Susceptible (C+D+E)	Total	Segregation ratio	X^2	P
1960	P123					115				115			
	P123×M503	15	8	12	18	10		35	28	63	9:7	0.013	0.8-0.9
	M503	1	3	8						12			
	P123×T208	59	9	43	20	11		111	31	142	3:1	0.760	0.3-0.5
	T208	54	46							100			
	P123×P167	72	28	19	14	13		119	27	146	3:1	3.297	0.05-0.1
	P167	64	17	10						91			
	P138					12	10			22			
	P138×7101	18	12	26	9	12		56	21	77	3:1	0.212	0.5-0.7
	P163	116	39	5	1	15	1			177			
	P163×7245	23	86	23	13	28		132	41	173	3:1	0.156	0.5-0.7
	7245	99	16	1	1					117			
	P163×9781	30	61	15	7	19		106	26	132	3:1	1.980	0.1-0.2
	9781	15	21	13	1					22			
	P163×9783	42	67	7	6	39		116	45	161	3:1	0.748	0.3-0.5
	P163×A73	31	50	8	1	32		89	33	122	3:1	0.273	0.5-0.7
	J302×T234	102	32	23	16	6		157	22	179	3:1	15.421	P> 0.01
	P141×P167	67	23	23	17	11		113	82	141	3:1	1.988	0.1-0.2
	P141					8				8			
1961	P123×P130	39	59	12	12	49	1	110	62	172	9:7	4.148	0.02-0.05
		98		24		50					9:3:4	3.266	0.1-0.2
	P130	22	37	5	4	30	2			100			
	P123×7114	34	77	10	16	61	2	121	79	200	9:7	1.468	0.2-0.3
		111		20		63					9:3:4	6.927	0.02-0.05
	7114	55	39	1	4	1		95	5	100			
	P124	45	20	3	8	24				100			
	P124×T215	34	22		5	31	2	56	38	94	9:7	0.421	0.5:0.7
	T215	14	35	15	2					66			
	P138×7247 (I)	11	17	7	12	2		35	14	49	3:1	0.333	0.5-0.7
	(II)	56	14	28	13	17	4	98	34	132	3:1	0.040	0.9-0.95
	7247 (I)	11	5	2	4					22			
	(II)	69	5	6	4	2				86			
	P123 (II)			1	3	64	9			77			
	P123×215 (I)	11	4	10	7	54	1	25	62	87	1:3	0.648	0.3-0.5
	(II)	20	3		3	58	6	23	67	90	1:3	0.015	0.8-0.9
	T215 (I)	14	35	15	2					66			
	(II)	70	26	2	2					100			

(I) Data of 1960. (II) Data of 1961.

The F_2s of the crosses, P123×M503, P123×P130, P123×7114 and P124×T215, 9 resistant and 7 susceptible plants were segregated. The chi-square value showed good fits to the expected ratio. When we classify the degree of resistance into three classes, resistant (O+A), intermediate (B+C) and susceptible (D+E) a 9:3:4 ratio was observed in P123×P130 and P123×7114. These facts indicate that at least two genes are

concerned with regard to leaf blast resistance. This assumption was confirmed by the second series of experiment conducted under the field condition.

DISCUSSION AND CONCLUSION

It will be concluded from the above mentioned results, that in the most crosses, the F_2s showed monogenic segregation, but some crosses showed a 9:7 ratio indicating that at least two genes are responsible for resistance to leaf blast. Sasaki (1922) reported that resistance to leaf blast is controlled by a single dominant gene. Nakamori (1926) and Hashioka (1950) concluded from their genetic studies that at least two dominant genes are responsible for resistance of blast disease.

A 9:7 ratio found in this study, whether represented a complementary effect of two genes or due to biased representation of a 9:3:3:1 ratio is a problem to be clarified. In view of 9:3:4 ratio found in some crosses, it is inferred that the resistance may be due to two dominant genes with supplementary effect. However, further studies are necessary to clarify this point.

The other thing to be considered might be whether or not there are physiological races with different reactions to varieties. Hashioka (1950) could not get a positive evidence for the presence of them. In Japan the existence of pathogenic races of blast fungus has been proved in the joint work done by various Agricultural Experimental Stations. Hokaido Agricultural Experimental Station (1957, 1958) made genetical studies on blast resistance in rice with race C-II, showing monogenic segregation in four out of six crosses. Whether other races will give the same pattern of segregation ratio to the same crosses is not known. In Taiwan Agriculturl Research Institute four pathogenic races have been identified. The writers are now on the way to study whether there is different reaction of different races to the segregation ratio of the above mentioned materials.

SUMMARY

Six resistant, six intermediate and seven susceptible varieties of rice from Taiwan, Japan and the U. S. A. were intercrossd, and were planted in a glass-house where humidity and temperature were controlled. Artificial inoculation of blast pathogen on the seedlings of rice was made and the infected leaves were exammined with regard to the type of disease lesions.

It was found that crosses between resistant and susceptible strains, in F_2, segregated into 3 resistant and 1 susceptible plants in majority of crosses, showing resistance to be controlled by a single dominant gene. In F_2s of some other crosses showed a 9:7 and 9:3:4 ratios indicating at least two genes are concerned with regard to blast resistance. The physiological races of pathogenes in relation to effect on the segregation ratio were discussed.

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稻之遺傳因子分析

第二報　稻苗對稻熱病抵抗性之遺傳

謝順景　簡錦忠　黃盛姣

摘　　要

就來自臺灣，日本及美國稻品種20種互交，並將其 F_2 及雙親，同時種在能調節溫度及濕度之玻璃室內。二星期後將經人工培養的稻熱病菌 (*Piricularia Oryzae*) 接種於稻苗上，病發後調查病葉的病斑型。

大部分的抗病×感病之雜交組合，在 F_2 分離為 3 抗病 1 感病之比率，表示抗病受一對顯性遺傳因子支配。其他雜交組合則表示 9：7 及 9：3：4 之分離比，表示抗葉稻熱病至少受兩對顯性遺傳因子支配。稻熱病菌生理型對分離比之影響，亦曾加以討論。

放射能處理甘藷儲藏研究及處理後營養分之變遷*

繆進三　鍾桂堂

一、緒　　言

目前歐美各國，對于食物儲藏，如肉類、奶汁、蔬菜、果品等，均已試行應用放射能處理。至目前爲止，其實驗結果，認爲放射能處理，尙不能完全代替其他食物儲藏處理之方法。但其逐漸發展，在適當條件與專門目的之下，可用爲現在通行儲藏方法之補助措施。如冷凍、加熱，化學藥品，脫水，抗生素之應用等儲藏處理方法，配合以較低劑量之適當放射能處理，當可逐漸達到經濟上應用之目的[3]。據 Connor, Johnson, Metta 及 Tsien 等氏報告[2,4]，渠等曾用 Gamma 線 3,000,000 r 消毒牛肉、牛奶、麵粉及各種豆類蔬菜，以便保存。研究結果，放射能消毒之肉、乳含有之氮化物及其消化率、吸收率與生肉、生牛乳無大差異，或差異不甚顯著。氏等用感受放射線之牛肉與麵粉分三組飼養23星期年齡之雌鼠，每星期調查其體重增加之數量，結果表示對其生長發育並無影響。

A. H. Sparrow 與 E. Christensen 二氏[1]以馬鈴薯爲研究材料，在美國 Brookhaven 研究所，經過數年之研究，照射 CO^{60} r- 線，其劑量爲 1,250, 5,000, 20,000 與 80,000 r。處理後並予冷藏。迨 8 個月後觀察，認爲 5,000 r 及 20,000 r 兩處理情形較佳，其餘者均略呈軟化。至18個月後，5,000 r 及 20,000 r 仍然較堅實，對照處理則已更形柔軟皺縮。至於前二處理食味品質，仍無大變化。但原作者未有化學分析報告，僅謂高劑量處理對維他命含量可能減少，蓋基于英國方面對于桔汁之分析報告如此。

想及本省馬鈴薯出產不多，而甘藷生產甚爲普遍，甘藷儲藏，在南部則製簽日晒乾燥，在北部冬季甘藷收穫期逢雨季，製簽晒乾，頗有困難。本研究乃倣照歐美馬鈴薯儲藏試驗，希望使用本地易得之放射能來源，處理甘藷塊根，而延長其儲藏期間，研究適當劑量及儲藏方法，使儲藏期間之品質損害最低，而儲藏期間可以延長最久。本研究以使用 X射線較爲方便，係與國立清華大學原子科學研究所合作辦理者。

二、研　究　目　的

(一)探求以何種 X光劑量照射甘藷，對防止發芽及防止病蟲害，延長儲藏期最有效果。

(二)研究 X射線處理甘藷塊根後，其所含營養分之變化。

(三)以小白鼠作營養試驗，觀察其食用放射能處理之甘藷塊根，對其身體影響如何。

三、試驗材料及處理强度

本試驗使用臺農57號紅心甘藷120條，臺農58號黃心甘藷120條。另以臺農57號甘藷處理 x-ray 7,000 r 及 10,000 r 劑量共 100 條爲動物飼養用。以上均儲藏于特製之通氣鉛絲櫥中。至于處理强度參照臺大農學院科學農業雜誌迻譯國外文獻，對于糧食儲藏處理，因處理目的而使用之放射量如下：

* 本篇承國家長期發展科學委員會于民國四十八年度補助研究

處理目的	放射量 reps
抑止洋葱馬鈴薯或胡蘿蔔之發芽	5,000～15,000
毀滅旋毛蟲(寄生蟲)	25,000～50,000
驅除昆蟲	50,000～100,000
抑制菌黴	150,000～250,000
低度殺菌	500,000～1,000,000
殺菌	2,000,000～5,000,000

本研究初期預備試驗參照上述强度擬定照射劑量等級如下：

(1) 10,000 γ (x-ray)

(2) 30,000 γ (x-ray)

(3) 70,000 γ (x-ray)

(4) 140,000 γ (x-ray)

(5) 430,000 γ (x-ray)

(6) 1,000,000 γ (x-ray)

上述各處理，每處理塊根5條，于48年11月24～27日在清華大學研究所物理系加速器研究室進行，照射完畢。由于處理後兩個半月(75日)觀察，自14萬γ照射量以上各處理，均已軟化，似不合儲藏目的，可能使用劑量嫌高，乃另行設計一萬γ以下各照射强度之處理。此項劑量乃美國白克海芬 (Brookhaven) 研究所，專爲馬鈴薯儲藏處理所應用之强度，而推想較爲適宜之强度範圍。

(1) 1,250 γ

(2) 5,000 γ

(3) 7,000 γ

(4) 10,000 γ

每處理亦爲塊根5條，于49年1月15日仍在清華大學加速器研究室處理完畢。

四、研究結果

關于第一批處理材料 (48年11月24～27日處理) 于49年2月12日即處理後75日觀察結果，大抵 x-ray 7萬γ以下之劑量，對防止發芽確有效果，而7萬γ以上之劑量等級，自14萬γ起，處理後不久，甘藷塊根卽行軟化。

x-ray 劑量	甘藷品種	處理後反應	對照情形 (未經處理者)
1萬γ	臺農57號	軟化(可能有誤差)未發芽。	正常，已發芽。
	臺農58號	正常，未發芽。	正常，已發芽。
3萬γ	臺農57號	正常，未發芽。	正常，已發芽。
	臺農58號	正常，未發芽。	正常，已發芽。
7萬γ	臺農57號	正常，未發芽。	正常，已發芽。
	臺農58號	正常，未發芽。	正常，已發芽。
14萬γ	臺農57號	處理後21日開始軟化，未發芽。	正常，已發芽。
	臺農58號	處理後14日開始軟化，未發芽。	正常，已發芽。
43萬γ	臺農57號	處理後7日開始軟化，未發芽。	正常，已發芽。
	臺農58號	處理後7日開始軟化，未發芽。	一條軟腐，其他正常，已發芽。

100萬γ	臺農 57 號	處理後2日即軟化，未發芽。	正常，已發芽。
	臺農 58 號	處理後立即軟化，未發芽。	正常，已發芽。

本試驗處理3萬γ以上之高劑量，使甘藷塊根水分失去較對照組（未經處理者）爲快。所受劑量愈高，水分失去愈快。又受上列劑量處理者均未發芽，而未經處理之對照組則發芽甚長，且有患軟腐病者一條，經處理者則未有病害。根據本試驗，7萬γ似爲甘藷儲藏處理所能忍受之最高劑量。7萬γ以上之處理，在處理後兩個半月甘藷塊根物理性質先後劣變(軟化)，似無經濟價值。又處理後可能塊根肉質細胞膜已被冲擊破壞，而胡蘿蔔素亦已減損，因由于胡蘿蔔素（細胞內含物）在塊根橫切面形成之橙紅色暈環，未處理者界線甚爲鮮明，被x-ray處理者其橫切面暈環已模糊，且顏色變淡。

處理後塊根之化學成分與未經處理者比較其維他命A、C兩部分之變化情形如次：

x-ray 處理後甘藷塊根 Vitamin C 減損情形表（處理後14日分析）

塊根處理劑量	重複	各等級照射量處理後 Ascorbic Acid 含量	對照（未經處理）之 Ascorbic Acid 含量	指數 各處理	指數 對照
1萬γ	I	20.1 mg/100gm	25.6 mg/100gm	78.51	100
	II	18.7 mg/100gm	26.2 mg/100gm	71.37	100
3萬γ	I	23.7 mg/100mg	24.7 mg/100gm	95.95	100
	II	24.0 mg/100gm	25.6 mg/100gm	93.75	100
7萬γ	I	8.24 mg/100gm	21.6 mg/100gm	38.14	100
	II	8.61 mg/100gm	21.6 mg/100gm	39.86	100

x-ray 處理後甘藷塊根胡蘿蔔素減損情形表（處理後14日分析）

塊根處理劑量	重複	各等級照射量處理後 Carotene 含量	對照（未經處理）之 Carotene 含量	指數 各處理	指數 對照
1萬γ	I	295 γ/100gm	646 γ/100gm	45.66	100
	II	295 γ/100gm	606 γ/100gm	68.67	100
3萬γ	I	328 γ/100gm	750 γ/100gm	43.73	100
	II	298 γ/100gm	740 γ/100gm	40.27	100
7萬γ	I	317 γ/100gm	535 γ/100gm	59.25	100
	II	337 γ/100gm	535 γ/100gm	62.99	100

以上所用品種爲臺農57號(紅心甘藷)係由本系派員與國防醫學院生化系合作分析。每組用爲對照者均爲與被照射處理大小相似之塊根。由上面兩表觀察甘藷塊根之內含物維他命A、C經x-ray處理後均有損失。胡蘿蔔素約損失31～61%，Vitamin C 約損失 4～62%。但各處理等級間之損失情形理應有一減損之趨勢線，但在本試驗結果未能明顯表示，可能由于試驗重複較少而爲試驗誤差所蒙蔽。不過可得一概念 x-ray 處理甘藷塊根，自 10,000～70,000γ 之强度，均使其內含物維他命A、C有損失情形。其後復于儲藏後四個月(即5月15日)將低劑量處理之臺農57號甘藷塊根各兩條 5,000γ 及 10,000γ 兩平準，另一組爲對照，分析其維他命A、C含量其結果如下列所示：

x-ray 劑量	Ascorbic acid 含量 mg/100gm	Carotene 含量 I.U./100gm
對照(未處理)	21.15	7,100

5,000γ 處理	20.70	7,400*
10,000γ 處理	20.02	6,900

* 此數字恐有試驗誤差因素在內。

根據上表分析結果，可知處理後維他命 A、C 之含量，大都均有減少。(惟 Carotene 含量在 5,000γ 處理之甘藷，反略有增加，想爲試驗誤差之故)。惟根據本組分析結果，在低劑量情形下，其減損情形並不十分嚴重。

關于氨基酸之分析工作與臺灣大學畜產系家畜營養研究室合作，發現經 x-ray 處理之甘藷塊根，由 70,000γ 至 140,000γ，其總蛋白質量，總氨基酸量，及氨基酸種類均無顯著變化。

①關于粗蛋白質總量之分析結果：

	水份		粗蛋白質 N×6.25	
對照(甲) (無處理)	I	69.93%	I	3.39%
	II	69.88%	II	3.42%
	平均	69.90%	平均	3.395%
14萬γ 處理	I	70.82%	I	3.55%
	II	71.02%	II	3.61%
	平均	70.92%	平均	3.58%
對照(乙) (無處理)	I	69.76%	I	3.31%
	II	70.23%	II	3.36%
	平均	69.99%	平均	3.335%
7萬γ 處理	I	70.64%	I	3.41%
	II	70.71%	II	3.34%
	平均	70.67%	平均	3.375%

由上表觀察，處理後粗蛋白質量似有微量增加，但因樣品甚少，由生物統計觀點此項差異大體在不顯著範圍之內。故可謂X線處理甘藷塊根粗蛋白質量無大變化。7萬γ及14萬γ之處理如此，在此强度以下之劑量則影響可能更小。

②關于 Amino Acid 定性分析結果：

用 Tow Dimensional paper chromatography 二元式濾紙色層分析法結果，可鑑定之氨基酸種類爲：(1) Aspartic Acid (2) Glutamic Acid (3) Serine (4) Glycine (5) Threonine (6) Alanine (7) Lysine (8) Tyrosine (9) Phenylatanine 除此之外 (10) Valine (11) Methionine (12) Isoleucine 與 (13) Lencine 之 Spot 在此 Solvent system 中不能分離，另 Tryptophan 不能用酸水解法測定外，其他氨基酸未能在本試驗濾紙上顯示 Spot，在對照(未處理者)及 7 萬γ 及14萬γ x-ray 處理者相同。由上所獲結果可以得知，甘藷經過 x-ray 處理劑量高至 7 萬γ 以至 14萬γ 對蛋白質含量及對蛋白質內之九種以上之氨基酸，亦未有破壞作用。(見附圖VII～IX)故若用較低劑量，當更無影響。至于能否改變氨基酸之種類，當待日後之繼續研究。

處理後三個月觀察三個低劑量處理 (1,250γ, 5,000γ 及 10,000γ) 塊根表型，其對照各組 (即未處理 x-ray 各組) 均已發芽甚長，而 1,250γ 處理組亦已發芽甚長 (即 1,250γ 無抑制發芽作用) 此外 5,000γ, 7,000γ, 10,000γ 處理三組，對發芽均有抑制作用。此在臺農57號及58號兩品種情形相似。(圖 I～II)

處理後 5 個月，1250γ 處理組發芽甚長，而 5000γ 處理組之臺農58號亦已露出芽眼。7000γ

及 10,000 γ 兩處理組則已開始軟化。對照組塊根卽未經 x-ray 處理者，發芽更長，且已放嫩葉，故其內含養料已更多損失。(圖Ⅲ～Ⅵ)

關于儲藏期間失去重量情形，低劑量處理者，比對照組失去重量較慢，當 1,250 γ 處理組及對照組如除去芽條以後，其塊根重量比未發芽者失重更多。總觀本試驗 5,000 γ x-ray 處理組，塊根在處理後 5 個月仍然完整，且未發芽，似爲全試驗最有利之處理强度。

動物營養試驗，選擇體重在 8, 9, 10克左右之小白鼠，隨機分配各處理之飼養罐中，每罐一頭，每日飼餵甘藷切塊 3 克，沾豆油及麵粉一薄層，另稻谷 3 克，每晨換新飼料一次，其結果如下列：

甘藷儲藏處理後 4 個月開始白鼠營養試驗結果：

甘藷飼料處理	鼠號	體重變遷情形 (克)						比飼養開始時增重克數	平均增重
		5/13日	5/24日	5/31日	6/8日	6/16日	6/23日		
無處理(對照)	T_0 1	10.1克	12.5	14.0	13.4	16.6	18.5	+8.4	31.7/4 =7.92
	T_0 5	10.0	13.0	13.8	13.8	15.6	18.5	+8.5	
	T_0 8	9.0	11.3	11.2	11.6	12.6	14.5	+5.5	
	T_0 7	9.7	12.0	14.9	14.3	17.1	19.0	+9.3	
x-ray 7,000 γ 處理甘藷飼料	T_2 9	8.5	10.0	10.9	11.0	13.0	14.5	+6.0	25.1/4 =6.27
	T_2 10	10.5	13.0	13.9	13.8	15.8	16.5	+6.0	
	T_2 14	13.3	16.3	17.8	17.4	20.8	21.0	+7.7	
	T_2 15	9.1	11.0	11.5	11.6	12.6	14.5	+5.4	
x-ray 10,000 γ 處理甘藷飼料	T_4 17	8.7	9.5	10.1	10.3	10.7	11.0	+2.3	11.5/4 =2.87
	T_4 18	8.3	10.3	11.8	11.4	13.0	14.0	+5.7	
	T_4 19	7.8	9.0	9.4	8.8	9.3	9.5	+1.7	
	T_4 23	9.2	10.5	11.9	10.4	10.9	11.0	+1.8	

故由上表觀察，小白鼠食用 x-ray 處理之甘藷配合其他飼料，體重增加較慢，似因處理後之甘藷維他命成分不足爲其原因之一。此外處理後甘藷之食味，在儲藏 5 個月後試食，未經放射能處理之甘藷與 1,250 γ, 5,000 γ, 7,000 γ 者相比較，未經處理者味較甜且較粘，處理者(各處理)仍可食，甜度，粘度稍差，(甜度有減損，與馬鈴薯處理後甜度增加之情形恰相反。)[1]且有類似青草臭味，可能影響小白鼠之食慾，亦爲體重增加較慢原因之一。此外或尙有其他未知原因，使處理後之甘藷塊根，對小白鼠之營養價値減低。但 7,000 γ 處理者，與對照處理增重情形相差猶小。而 10,000 γ 處理者，則其增重情形相差甚大。

五、結 果 摘 要

① x-ray 一萬 γ 以上之劑量爲儲藏目的處理甘藷後，不久塊根均軟化，不能達到儲藏目的。

②一萬 γ 以下之劑量 x-ray 處理之甘藷儲藏期間，失去重量較慢，至儲藏後 3 個月止，一切正常，不發芽未腐爛。

③ x-ray 1,250 γ 無抑制發芽效果，處理後 3 個月，發芽甚長，其餘各處理組大都未發芽，僅臺農58號 5,000 γ 等級處理者露出芽眼。

④ 5,000 γ～10,000 γ 均有抑制發芽效果。

⑤處理後 3 個月 5,000 γ～10,000 γ 均表示對儲藏有利益，可以抑制發芽，水分失去較慢，未有腐爛。但對照組除發芽甚長外，亦少有腐爛，不過由于儲藏期間發芽關係，對照組水分乾物量均失

去較快。

⑥處理後4個半月 7,000 γ 及 10,000 γ 兩處理開始腐爛。

⑦ 5,000 γ 處理之甘藷，處理後5個月已稍稍發芽，表示生命力未喪失，且甚爲完整。

⑧化學成分分析，已知處理後維他命 A、C 均有損失，蛋白質，氨基酸無大變化。

⑨動物營養試驗41日間（5月13日以迄6月23日）以 7,000 γ 及 10,000 γ 兩種處理之甘藷，飼餵小白鼠與未處理之甘藷飼餵作對照，其增重情形，以對照最快，平均增重 7.92 克，7,000 γ 處理次之，平均增重 6.27 克，10,000 γ 處理更次之，平均增重 2.87 克。可能由于 x-ray 處理使甘藷維他命損失，而致營養價值降低，食用後影響白鼠之正常發育。亦可能由于處理後甘藷有特殊青草臭味，更影響小白鼠之食慾。本研究與國外同樣性質之試驗，行之於馬鈴薯者，可以參考印證，即 5,000 γ 左右之劑量，對儲藏最有利，而對營養分之損失較少；但放射能處理諸類塊根，對 Vitamin A、C 內含物均不免有損失。[4,5]而影響其營養價值。

本研究進行中，承本所農藝系研究助理王文中先生及張珍鉷鈕涵英二小姐惠予協助，附此誌謝。

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A STUDY ON THE EFFECT OF X-RAY EXPOSURE ON THE STORAGE QUALITY OF SWEET POTATO AND ON THE NUTRIENT CONDITION CONTAINED OF THE TUBER

by

T. S. MIU & K. T. TSON

SUMMARY

After a world-wide research on the application of atomic energy to agriculture and food production in different countries during the recent years, it is quite unlikely to replace entirely other methods of food preservation in the forseeable future, but that it will, for appropriate purpose, gradually come into use as a supplement to them under suitable conditions, each of the traditional methods of food preservation such as refrigeration, heat sterilization, or the use of chemical treatments and antibiotics is recognized as having specific advantages for particular kinds of foods. Therefore, there is a general interest in the study of applying low dosages of irradiation in combination with the methods of food preservation, in order to devise new improved

storage methods.

The present report is based upon a project studied in 1959–1960 at Taipei by the Dept. of Agronomy of the Taiwan Agricultural Research Institute, in which project the operation of x-ray irradiation was cooperated with Institute of Nuclear Science, National Tsing Hua University.

Tubers of sweet potato of two varieties, Tainung 57 and 58, was employed as the testing material. In order to study the effect of irradiation on the sweet potato tubers during storage, 4 sets of tubers of sweet potato were subjected to the exposure of x-ray on January 15, 1960. After being x-rayed, they were placed in airy wire case on the following days. The physiological and chemical changes of the x-rayed and the controlled tubers were compared in a series of studies.

It has been found that the application of dosages as high as 70,000 γ, 140,000 γ or higher to the tubers of sweet potato is not practical for the purpose of storage, for the tubers when subjected to such high dosages, become quickly or gradually softened within 3 months. Some of the tubers after being treated with 70,000 γ or higher dosages, a part of the flesh became turning brown in colour. But the treatments with lower dosages such as 5,000 γ and 10,000 γ seemed to be applicable for the purpose of tuber storage. In the observation made after the tubers were stored for three months, only with the exception of 1,250 γ level, no effect on the inhibition of sprouts was found. However, in the samples treated with 5,000 γ and 10,000 γ, sprouting was apparently reduced, and their weight loss during the storage was also reduced.

Even after a prolonging storage for 5 months, the sample with 5,000 γ treatment showed only some slightly budded eyes and its tubers still maintained a fresh condition, whereas the sample with 10,000 γ dosage has become decayed. The tubers used as control decayed also or sprouted with long stems and leaves, losting weight severely. It is thus concluded that the treatment with 5,000 r dosage could be advantageously used for storage purpose.

As for the chemical changes between the tubers x-rayed and the control, there seemed to be no significant difference in the change of crude protein and amino acids, but Vitamine A and C were inveritably decreased in the tubers even they were exposured to lower x-ray dosages.

In combination with the experiment, a biological assay was also conducted in the Institute. 3 sets of small white mice, two of which were fed mainly with some small slices of the x-rayed sweet-potato of different dosages and the rest one fed with the tubers of the control sample to serve as a check. After 40 days the latter set of mice appeared to increase body weight rapidly, but the first two sets of mice fed with the x-rayed tubers gained body weight rather slowly.

It is thus inferred that the difference of the body weight increased is due to the difference of Vitamine content of A and C in the x-rayed tubers. A nasty odor present in the x-rayed tubers seemed to be also a factor that effected the appetite of the mice.

甘藷塊根表型之比較

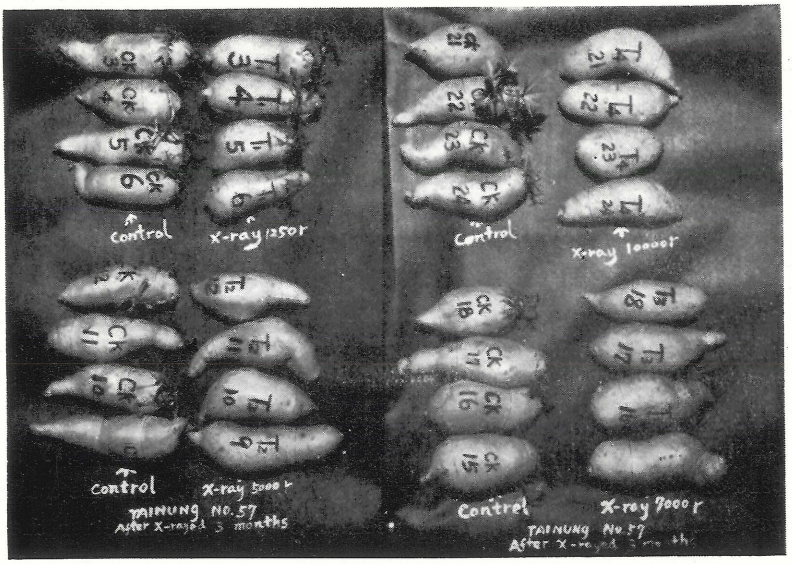


圖 I

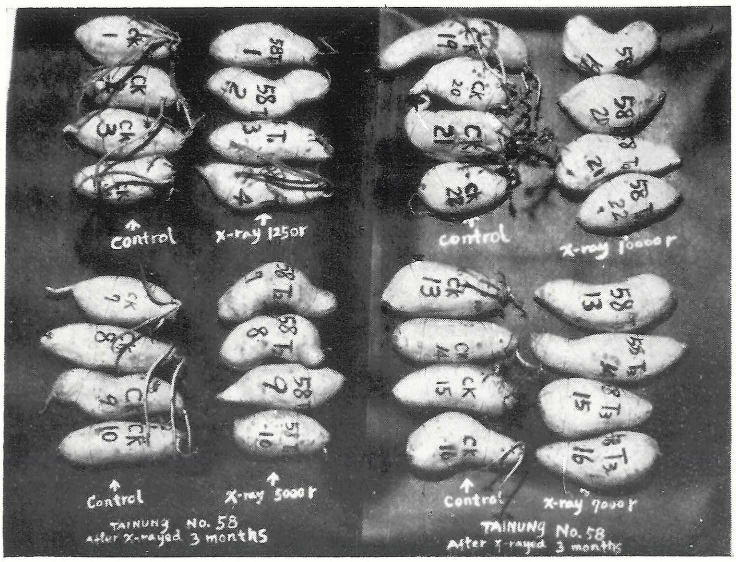
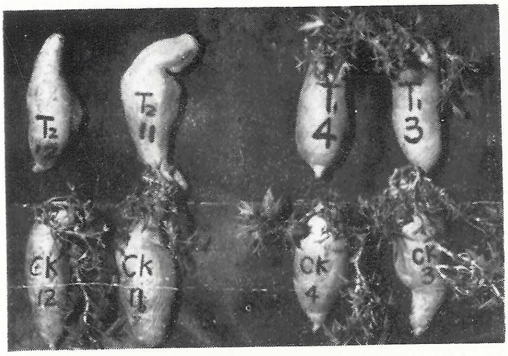
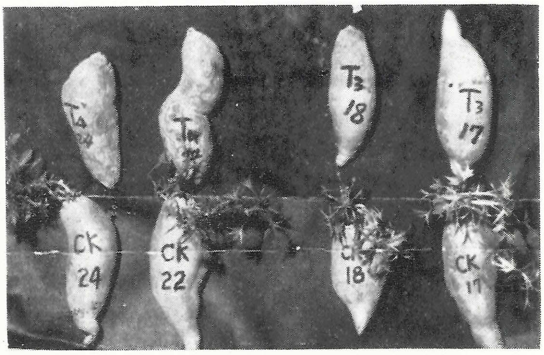


圖 II

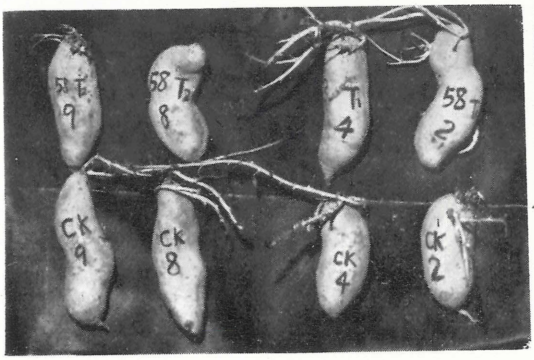
圖 I，II：甘藷塊根經X射線各級照射量處理後三個月表型圖



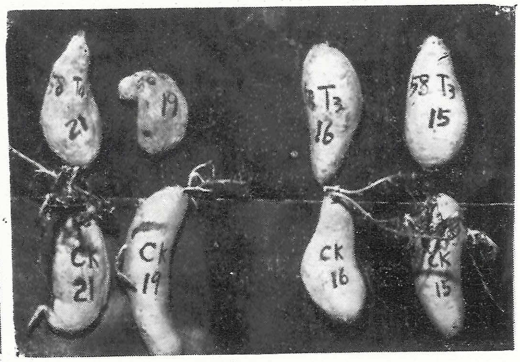
圖Ⅲ：(顯示 T_2 情形最佳)



圖Ⅳ：(顯示 T_4 已萎縮)



圖Ⅴ：(顯示 T_2 情形最佳)



圖Ⅵ：(顯示 T_4 已萎縮)

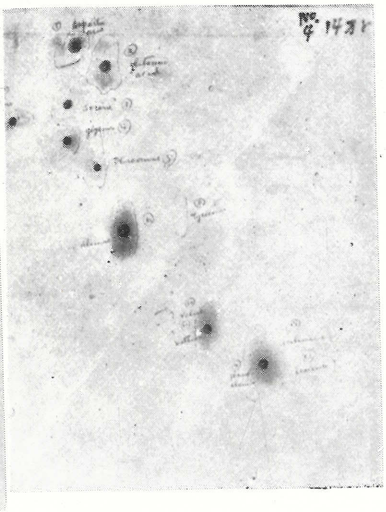
圖Ⅲ，Ⅳ。臺農57號甘藷；圖Ⅴ，Ⅵ。臺農58號甘藷。

經X射線照射後5個月表型圖（CK＝對照 $T_1=1,250\gamma$，$T_2=5,000\gamma$，$T_3=7,000\gamma$，$T_4=10,000\gamma$）

處理組與對照組氨基酸定性分析之比較

圖Ⅶ：對照(不處理)

圖Ⅷ：70,000γ



圖Ⅸ：140,000γ

圖Ⅶ，Ⅷ，Ⅸ：　處理(圖Ⅷ，Ⅸ)與未處理(圖Ⅶ)甘藷塊根所含氨基酸經定性分析在濾紙上所顯示之 Spot（表示並無重大差別）

金門早生球莖甘藍採種試驗

李 伯 年　　諶 靜 吾

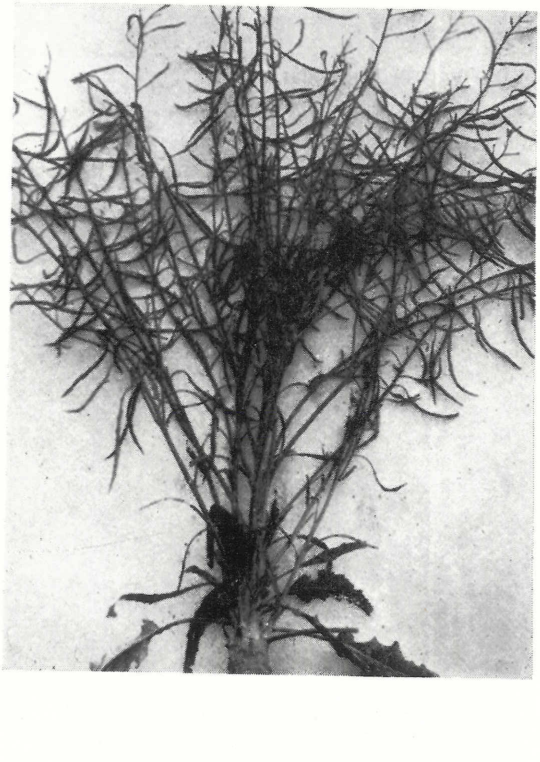
一、不同海拔地區採種試驗之成績

關於金門早生球莖甘藍之優點，本所出版之農業研究九卷二期及九卷四期論述甚詳，茲爲謀種子之自給，1958年曾在省內不同海拔地區進行採種試驗，目的在省內尋得一個穩定合適之自然環境，以謀優良種子之生產；在金門雖可採種，却因年平均溫度略嫌過高，至盛花後期，氣溫昇高較快，致種子形質，二年來採種之結果，均不見理想；又因金門屬前線戰地，工作上之困難極多，一切技術上之指導，未能如期達到，故此另找合適環境之採種地，實屬迫切需要。1958年秋季，選定省內九個地區，進行試驗，除南投縣鹿角鄉海拔 1,000 M 之溪頭、宜蘭縣太平鄉海拔 1,212 M 之俾南、臺中縣和平鄉海拔 1,750 M 之環山，因資料不全刪去，未列入比較外，茲將資料完整之六個地區，單株種子產量及形質之比較，分述如下。金門之記錄爲1957～58年期之成績，亦一併列入，藉資參考。

1. 臺北農業試驗所園藝系之成績——本所園藝系之地位海拔高度約15M，年平均溫度爲21.7°C，年降雨總量爲2,110.1mm，冬春兩季爲多濕之環境，土壤排水未見良好，9 月16日播種，10月15日定植，12月24日選拔球莖形態一致者，移植于一邊，3 月初旬開始抽苔，抽苔率可達98%，抽苔開花不結籽之植株佔35%，情形極不理想，開花結籽植株，每株有效莢數平均僅 190.25莢，每株平均種子收量僅2.39g，種子形粒粗細不勻，千粒重量僅 1.05g，比較優良結籽之植株，請參閱圖一。

2. 深坑砲仔崙三益農場之成績——三益農場位于臺北縣深坑鄉砲仔崙山腰，海拔高度 370 M

圖一　農試所園藝系金門早生球莖甘藍結籽狀況
Fig. 1　Planted at Dept. of Horticulture of TARI



年平均溫度及降雨總量不詳，土壤屬礫質，排水極良，10月20日定植，翌年3月中旬抽苔，抽苔率100％，抽苔開花之植株，結籽情形甚佳，平均每株有效莢數達413.42莢，每株平均種子收量多達15.89 g，種子形粒粗大而齊一，千粒種子重量爲3.10 g，優良植株之結籽情形，請參閱圖二。

圖二　深坑碗子崙三益農場金門早生球莖甘藍結籽狀況
Fig. 2　Planted at Shen-kang of Taipei Hsien

圖三　陽明山山仔後特約農戶金門早生球莖甘藍結籽狀況
Fig. 3　Planted at Shantzuhou of Yangmingshan

3. 陽明山山仔后特約農戶之成績——山仔后特約農戶之試驗地，位於陽明山管理局之下，海拔高度約爲 470 M，冬春兩季亦多濕，土壤質地及排水情形均佳，因第一次育苗失敗，延至12月20日定植，翌年 3 月中旬開始抽苔，抽苔率 100 %， 植株較小， 生勢特强， 抽苔之植株，均滿開盛花，結籽情形非常良好，平均每株有效莢數爲 375.65 莢，每株平均種子收量爲 11.07 g，種子形粒整齊，千粒重量 2.82g，優良植株之結籽情形，請參閱圖三。

4. 陽明山竹子湖特約農戶之成績——竹子湖特約農戶之試驗地，位于派出所對面之山腹，海拔高度 660 M，年平均溫度 16.2°C，年降雨總量多達 5979.7mm，爲臺灣北部冬春兩季最潮濕之地區，土壤質地及排水均佳，12月20日，由士林分所培育完成之大球莖，移植二十株于該地，因冬季多濕之故，移植後曾死去三株，翌年 3 月下旬開始抽苔，抽苔率 100 %，頗爲整齊，4 月初旬至 4 月中旬，盛花季節，雖陰雨連綿不停，結籽情形，仍屬理想， 6 月10日未待十分黃熟，陰雨中收穫種子，風乾後脫粒，每株平均種子收量可達 11.49 g，種子形粒整齊，千粒重量 3.15 g，優良植株之結籽情形，請參閱圖四。

圖四 陽明山竹仔湖特約農家金門早生球莖甘藍結籽狀況
Fig. 4 Planted at Chutzuhu of Yangmingshan

5. 花蓮西寶農場之成績——西寶農場位于花蓮縣秀林鄉太魯閣，名勝集中地之西寶村，海拔高度1020M，年平均溫度及降雨總量不詳，冬春兩季氣候溫涼乾燥，土壤爲礫質，排水極良好，日照充足，9 月18日播種，10月20日定植，翌年 2 月下旬開始抽苔，抽苔率 100 %，非常整齊， 2 月下旬至 3 月初旬爲盛花季節， 4 月28日收穫種子，平均每株有效莢數多達1,396.0莢，每莢種子含量亦多，平均每株種子收量多至 42.40 g，產量甚豐，種子形狀較小而整齊，千粒種子重量 2.50 g，優良植株之結籽情形，請參閱圖五。

6. 臺中福壽山農場之成績——福壽山農場位于臺中縣和平鄉之梨山， 海拔高度 2,248 M，年平均溫度12.14°C，年降雨總量不詳，冬春兩季爲乾燥季節，冬季甚冷，夏不極熱，土壤屬腐植質，排水尙可， 2 月15日由農業試驗所培育完成，選擇優良之大球莖，由臺北運往山上採種，共移二十

圖五 花蓮西寶農場金門早生球莖甘藍結籽狀況
Fig. 5 Planted at Hsipao of Hwalien Hsien

圖六 臺中福壽山農場金門早生球莖甘藍盛花狀況
Fig. 6 Planted at Fushoushan Farm of Taichung Hsien

株，栽植後 100 %活着，因山上春季平均溫度較低，延至 4 月下旬開始抽苔，抽苔率達 100 %，生勢並不弱，却因溫度昇高緩慢，平均氣溫一直停留在 13°C 左右，到 5 月上旬至 5 月下旬始達盛花期，種子收穫在 7 月10日，其間結莢時期，受蚜蟲爲害，收量銳減，平均每株有效莢數138.2莢，每株平均種子收量 5.27 g，種子形粒大而整齊，千粒種子重量 3.25 g，優良植株之盛花情形，請參閱圖六。

7. 金門大洋村之成績——金門大洋村特約農戶之試驗地，位于金門島金沙鎮之東北海邊，海拔高度僅10M，年平均溫度 20.8°C，年降雨總量 1322.1 mm，冬春氣候乾燥，極少降雨，土壤屬砂質，排水良好，灌溉亦便，本爲理想之採種地，因平均溫度略嫌稍高，每至春季盛花季節，氣候過于乾燥，且春季溫度升高亦較快，至結籽時期，種子無法充分發育，形粒大多變小，平均每株有效莢數 1237.2莢，每株種子平均收量爲30.39g，千粒種子重量爲 1.84 g。

8. 鳳山及士林試驗分所之成績——鳳山分所試驗地，年平均溫度超過23°C，留十株觀察其抽苔情形，多數均不抽苔，僅少數微現花苔，而難開花，見圖七。

士林分所亦留十株作觀察，僅一株收得種子，其餘九株未待開花即被拔去，由此觀察在臺灣平地，北部較南部留種可能性較大，欲望單株種子收量豐多，受氣溫限制，爲不可能之事。

圖七　金門早生球莖甘藍在鳳山分所抽苔不開花情形
Fig. 7　Planted at Fengshan Tropical Horticultca Experiment Station

二、早植與晚植之採種成績

早植與晚植原計劃設在臺北區海拔300～700M之試驗地，早植區預定10月15日前後定植，晚植區于11月15日前後定植；在橫貫公路宜蘭支線區海拔1200～1800M之試驗地，早植區預定 8 月15日前後定植，晚植區 9 月15日前後定植。目的在求合適之栽培期，以求採種量之增多，因宜蘭支線交通未能暢通，工作有所困難，停止進行。玆將臺北區之研究結果，分述如下：

臺北區之試驗地，海拔不高，二個試驗特約農戶，早植者一切情形較晚植者爲佳，花苔高而分枝多，種莢長而每株有效莢數亦多，因此單株種子收量，早植者較晚植者爲豐，早植者平均每株種子收量爲 13.69 g，晚植者僅 8.56 g，計算早植之增產率爲 37.4%。詳見表二。

三、移植與不移植之採種成績

在金門球莖甘藍之採種農戶，每在球莖甘藍育苗定植以後，六十天左右，淘汰劣株，擇球莖品型一致者，再重新移植一次，待其開花結籽；此種方法，在原種或原原種育種選擇，固爲必經之步驟，一般採種圃，面積廣大，如此操作，實嫌其煩，成本亦因而增大。但移植後根據金門大洋村，花蓮西寶二個試驗地之結果，普遍植株變矮，分枝減少，莢長縮短，每株有效莢數及每莢有效種子數大減，種子形粒變小，單株種子收量亦因此而減少；不移植者單株種子收量二個試驗地平均爲 36.44 g，移植者僅 14.10 g，移植後計算其減產率爲 61.30%，詳見表三。

表一 不同海拔高度與種子產量及形質之比較

Table 1. Comparison of the Seed Productions and Characters of Kinmen Early Kohlrabi at the Various Altitudes

採種地點 Places	海拔高度 Altitude (m)	年平均溫度 Annual mean temperature (°C)	調查株數 Plants observed	調查項目（每株平均數） Examination of items: 花苔高度 Height of flowering stems (cm)	分枝數 Number of branches (枚)	莢長 Length of pods (cm)	有效莢數 Number of available pods per plant (枚)	每莢有效種子數 Number of available seeds per pod (粒)	每株種子量 Number of seeds per plant (粒)	千粒種子之重量 Weight of 1,000 seeds (g)	折算每株種子量 Yield of seeds per plant (g)
金門大洋村 Kinmen	10	20.8	10	87.40	19.50	7.28	1,237.20	13.35	16,516.62	1.84	30.39
臺北農試所 TARI	15	21.7	10	73.50	20.80	6.74	190.25	7.62	1,449.70	1.65	2.39
深坑砲子崙 Shenkang	370	—	10	96.82	18.70	8.02	413.42	12.40	5,126.40	3.10	15.85
陽明山山仔後 Shantzuhou	470	—	5	77.57	16.60	6.84	375.65	10.45	3,925.54	2.82	11.07
陽明山竹子湖 Chutzuhu	660	16.2	10	95.65	17.90	7.86	474.57	11.27	5,348.40	2.15	11.49
花蓮西寶 Hsipao	1,020	—	10	105.90	24.80	6.17	1,396.00	12.15	16,961.40	2.50	42.40
臺中福壽山 Fushoushan	2,248	12.1	8	81.34	14.20	5.37	138.20	11.83	1,634.90	3.23	5.27

表二　早植與晚植與採種量之比較

Table 2. Comparison of the Seed Productions according to Planting Dates

試驗地點 Places	處理 Treatments	調查株數 Plants observed	調查項目（每株平均） Examination of items: 花苔高度 Height of flowering stems (cm)	分枝數 Number of branches (枚)	莢長 Length of pods (cm)	每株有效莢數 Number of available pods per plant (枚)	每莢有效種子數 Number of available seeds per pod (粒)	每株種子數 Number of seeds per plant (粒)	千粒種子重量 Weight of 1,000 seeds (g)	折算每株種子量 Yield of seeds per plant (g)
深坑砲仔崙 Shenkang	早植 10月15日定植 Oct. 15 setting	10	96.82	18.70	8.02	413.42	12.40	5,126.40	3.10	15.89
陽明山竹子湖 Chutzuhu	早植 10月16日定植 Oct. 16 setting	10	95.65	17.90	7.86	474.57	11.27	5,348.40	2.15	11.49
	平均 Average	10	96.24	18.30	8.44	443.99	11.84	5,237.40	2.62	13.69
深坑砲仔崙 Shenkang	晚植 12月10日定植 Dec. 10 setting	10	89.60	16.40	7.11	305.82	10.75	3,287.56	2.80	9.20
陽明山竹子湖 Chutzuhu	晚植 11月16日定植 Nov. 16 setting	10	77.57	16.60	6.84	375.65	10.45	3,925.54	2.02	7.92
	平均 Average	10	83.58	16.50	6·97	340.74	10.60	3,606.55	2.41	8.56

表三 移植與不移植與種子產量及形質之比較

Table 3. Comparison between Transplanting and Non-transplanting of Productions and Characteristics of the Seed

試驗地點 Places	處理 Treatments	調查株數 Plants observed	調查項目（每株平均） Examination of items							
			花苔高度 Height of flowering stems (cm)	分枝數 Number of branches (枚)	莢長 Length of pods (cm)	每株有效莢數 Number of available pods per plant (枚)	每莢有效種子數 Number of available seeds per pod (粒)	每株種子數 Number of seeds per plants (粒)	千粒種子重量 Weight of 1,000 seeds (g)	折算每株種子量 Yield of seeds per plant (g)
金門大洋村 Kinmen	不移植 Non-transplanting	10	87.40	19.50	7.28	1,237.20	13.35	16,516.62	1.84	30.39
花蓮西寶 Hsi-Pao (Hwalien)	不移植 Non-transplanting	10	105.90	24.80	6.17	1,396.00	12.15	16,961.40	2.50	42.49
	平均 Average	10	96.65	22.15	6.72	1,316.60	12.75	16,739.01	2.17	36.44
金門大洋村 Kinmen	移植 Transplanting	10	70.32	15.60	5.32	967.40	6.25	6.046.25	1.23	7.43
花蓮西寶 Hsi-Pao	移植 Transplanting	10	87.10	24.80	5.27	1,396.00	7.67	10,707.32	1.94	20.77
	平均 Average	10	78.71	20.20	5.29	1,181.70	6.96	8,376.78	1.58	14.10

說明：①金門大洋村之試驗記錄爲1957～58年期之成績

②花蓮西寶農場之試驗記錄爲1958～59年期之成績

四、結　　　論

1. 金門早生球莖甘藍在臺灣北部平地，可以抽苔開花結籽，但在盛花期中，因春雨綿綿不停，土壤排水不良之地，收籽甚難，且形質極差。

2. 海拔 370 M之深坑砲仔崙山地，及海拔470～690M之陽明山山仔後，竹子湖山地，土質鬆鬆，排水良好，雖春季多雨，仍可結籽優良，其種子形質亦佳。

3. 海拔1020M之西寶農場，春季氣候穩定，雨水亦少，為採種之合適環境，不特單株收量豐富，且種子形質亦良。

4. 海拔2248M之福壽山農場，春季溫度昇高極緩，延至夏初抽苔開花，至種子結實成熟時期之六、七月間，適為夏季雨期，豪雨連綿，雖可收得種子，不特產量不豐，且處理上困難特多。

5. 如原種育成完善，採種圃生產種子，可免選種移植，以節省勞力，而增種子產量；為謀單位面積收量之增多，在合適之環境採種，可儘量提早栽植。

TEST ON THE SEED PRODUCTION OF KINMEN EARLY KOHLRABI

by

P. N. Lee & C. W. Shen

SUMMARY

1. Kinmen Early Kohlrabi is capable of bolting, flowering and seeding in northern plain of Taiwan. However, owing to long-period spring rain, seedings are difficult in ill-draind paddy field, and their characteristics are low.

2. Mountain areas of Shen-kang, Pao-tzu-lun (altitude 370 m.) and Yangmingshan, Shan-tzu-hou, Chu-tzu-hu (altitude 470–660 m.) have well-drainage soil. Seedings are good despite of spring rain, the characteristics of the seeds are also good.

3. Hsi-pao Farm (altitude 1,020 m.) has less rain, and a still spring weather, therefore, is a suitable place for seed-picking. Not only the single-plant harvests well, but also the characteristics of seeds are good.

4. Fushoushan Farm (altitude 2,248 m.) temperature picks up very slowly in spring, bolting and flowering must be as late as early summer, ripening stage is on June and July when comes upon rain season. Heavy rain makes harvest impossible, also difficulty in disposing the seeds.

5. If the original seed brings up well, seed produced from extension seed farm do not need to be selected and transplanted so as to save labour and stimulate seed production; in order to improve unit yield, it is recommended to plant earlier in suitable picking environment.

利用葉分析診斷柑桔營養狀態之研究

邱再發　林森岷

一、緒　言

藉植物分析以解決植物生育之營養問題，刻漸爲一般學者所提倡[1,2,3,4,5,6]而逐漸形成爲植物營養診斷之方法。在各地許多學者分別對各種作物分析葉之無機成分，此等化學分析因各方之注意研究益趨進步完善而能够判定有關植物健全與否之各種營養元素之濃度水準，他們表示葉分析是診斷植物養分之缺乏或過剩之良好工具。過去利用土壤分析解決植物營養及土壤肥力問題雖有顯著進步，但無法避免之缺點仍多，譬如對土壤中各種養分已有各種抽出劑之案出但尙未能正確測定土壤所能供給之養分含量，蓋植物吸收養分之機構複雜，實未便以土壤抽出劑單純定量之。反之植物體中所含養分可因土壤中養分之多寡以及肥料之施用而有變化，故引起農學者之注意及興趣，認爲合理的土壤肥力及植物營養之研究，宜以植物爲對象。

在臺灣對鳳梨[7]茶[8]水稻[9]也有進行葉診斷法研究，惟至應用階段尙須繼續進行基礎研究。柑桔爲戰後在臺灣發展之新興作物之一，近年來其果實之出口頗受各地之贊揚。但柑桔施肥問題因缺乏試驗資料，柑農未能實施合理的施肥管理，所以影響其生產甚大，農試所由1958年開始柑桔園施肥試驗[10]，現在利用該試驗處理區之柑樹爲材料，進行柑桔葉診斷法之研究供爲柑桔施肥之應用。

二、材料與方法

1. 研究材料

使用柑桔園施肥試驗地之椪柑樹爲本研究之基礎材料，該試驗[10]爲 1958 年 1 月開始肥料處理本報告之材料爲1959年採取者該試驗分爲五處理三地點；

1）無氮區　2）無磷區　3）無鉀區　4）三要素區　5）三要素加微量元素區

1）新埔照門柑桔園(21年生)　2）新埔大坪柑桔園(19年生)　3）員林柑桔園(10年生)

2. 柑葉取樣方法

a）時期：在三月、五月、七月、九月、十一月分期採取柑葉，探求時期與柑葉養分含量之關係。

b）成熟度不同柑葉：採取成熟度不同柑葉，則由枝頂第一、二、三、四位置柑葉，分部位取樣，探求柑葉位置與其養分濃度之關係。

c）葉數；分別取樣20葉、40葉、80葉供爲分析，闡明取樣葉數與養分濃度之關係。

d）闡明施肥與柑葉養分之關係：分別取樣各施肥處理區之柑葉闡明施肥與柑葉養分含量之互相關係。一般係於所定時期選擇果樹外側周圍不着果枝，每樹約10～20枝，由每枝枝頂採取第3～4葉供爲分析。柑葉化學分析後並參考各肥料處理區之柑桔樹之肥料需要情形確立柑葉之氮、磷、鉀臨界濃度 (Critical percentage)。

3. 分析方法

柑葉樣本風乾後以粉碎機磨碎，然後在乾燥器85°C烘乾後定量氮、磷、鉀含量。氮以 Micro-kjeldaht 法定量：磷以 Piper 氏之 Micrs-digestion 法[11]分解樣本後以 Molybdenum-blue 比色法，使用還元劑 Hydrazin suephate[12]定量磷含量、再使用前述分解液以 Flame-phometric

當本研究之執行，蒙受國家長期發展科學委員會補助費附此謹申謝忱。

method[13]定量鉀含量。

三、結果與考察

1. 施肥對柑葉中氮、磷、鉀含量之影響

為比較各施肥處理區之柑葉中 N. P. K 含量，於三、五、七、九、十一各月份在三個試驗地對各施肥處理區進行採樣以供化學分析。結果如表 1, 2, 3 及圖 1, 2。表中各種元素之含量皆係二重覆平均，即各處理區在第 1~2 區集及第 3~4 區集所採者分別為第 1 及第 2 重覆，故每重覆樣品有同處理之試驗柑樹八顆，所採柑葉約 150~200 枚。

表 1. 肥料處理和採樣時期對柑葉氮素含量之影響(烘乾平均%)

Table 1. Effect of fertilizer treatment and time of sampling on the nitrogen contents in citrus leaves (mean N % on oven dry basis)

地點 Locality	處理 Treat-ment / 時期 Time	無氮區 PK	無磷區 NK	無鉀區 NP	三要素區 NPK	微量元素區 NPK+ Mn. Zn. Mg	平均 Average	L. S. D.
照門 Chawmen	三月 Mar.	2.79	2.74	2.77	2.95	2.80	2.811	
	五月 May	3.04	3.02	2.97	3.20	3.14	3.074	
	七月 July	3.14	3.23	3.26	3.16	3.22	3.201	時期間**
	九月 Sep.	3.09	3.32	3.27	3.23	3.29	3.243	5% 0.248
	十一月 Nov.	3.12	3.19	3.26	3.21	3.23	3.203	1% 0.337
	平均 Average	3.035	3.098	3.110	3.151	3.138	3.106	
	L. S. D.	處理間 N. S.			處理×時期 N. S.			
大坪 Taping	三月 Mar.	2.56	2.66	2.67	2.74	2.64	2.656	
	五月 May	2.73	3.07	3.14	3.21	3.14	3.060	
	七月 July	2.82	3.13	3.19	3.32	3.21	3.135	時期間**
	九月 Sep.	2.79	3.28	3.30	3.43	3.32	3.224	5% 0.215
	十一月 Nov.	2.91	3.29	3.26	3.33	3.29	3.218	1% 0.292
	平均 Average	2.763	3.088	3.114	3.206	3.122	3.058	
	L. S. D.	處理間**	5% 0.215 1% 0.292		處理×時期 N. S.			
員林 Yuanling	三月 Mar.	2.80	2.73	2.81	2.71	2.75	2.761	
	五月 May	3.05	3.13	3.24	3.22	3.07	3.146	
	七月 July	2.84	2.93	2.97	3.05	3.00	2.960	時期間**
	九月 Sep.	2.98	3.19	3.07	3.08	3.09	3.085	5% 0.139
	十一月 Nov.	2.96	2.96	3.00	3.03	3.08	3.007	1% 0.189
	平均 Average	2.928	2.992	3.019	3.021	2.999	2.992	
	L. S. D.	處理間 N. S.			處理×時期 N. S.			

註：**表示達到 1 %顯著標準，N. S. 表示不顯著。

表2. 肥料處理及採樣時期對柑葉磷素含量之影響(烘乾物百分率)

Table 2. Effect of fertilizer treatment and time of sampling on the phosphorus contents in citrus leaves (mean P % on oven-dry basis)

地點 Locality	處理 Treatment / 時期 Time	無氮區 PK	無磷區 NK	無鉀區 NP	三要素區 NPK	微量元素區 NPK+ Mn. Zn. Mg	平均 Average	L. S. D.
照門 Chawmen	三月 Mar.	0.144	0.117	0.118	0.123	0.121	0.1250	
	五月 May	0·168	0.157	0.151	0.156	0.158	0.1583	
	七月 July	0.152	0.137	0.138	0.138	0.142	0.1417	時期間**
	九月 Sep.	0.142	0.133	0.129	0.126	0.135	0.1333	5% 0.0180
	十一月 Nov.	0.164	0.157	0.153	0.151	0.151	0.1552	1% 0.0252
	平均 Average	0.1544	0.1405	0.1380	0.1392	0.1414	0.1427	
	D. N. S.		處理間** 5% 0.0180 1% 0.0252		時期×處理 L. S.			
大坪 Taping	三月 Mar.	0.122	0.114	0.124	0.119	0.124	0.1207	
	五月 May	0.171	0.146	0.168	0.162	0.164	0.1626	
	七月 July	0.148	0.132	0.147	0.139	0.139	0.1413	時期間**
	九月 Sep.	0.140	0.128	0.133	0.133	0.132	0.1335	5% 0.0207
	十一月 Nov.	0.169	0.133	0.145	0.137	0.138	0,1446	1% 0.0281
	平均 Average	0.1501	0.1309	0.1437	0.1385	0.1395	0.1405	
	L. S. D.		處理間** 5% 0.0207 1% 0.0281		時期×處理 N. S.			
員林 Yuanlin	三月 Mar.	0.150	0.141	0.162	0.145	0.150	0.1498	
	五月 May	0.163	0.163	0.161	0.170	0.168	0.1654	
	七月 July	0.128	0.124	0.134	0.130	0.133	0.1299	處理間**
	九月 Sep.	0.125	0.124	0.130	0.122	0.120	0.1245	5% 0.0147
	十一月 Nov.	0.130	0.124	0.136	0.143	0.127	0.1320	1% 0.0199
	平均 Average	0.1393	0.1355	0.1448	0.1422	0.1398	0.1403	
	L. S. D.		處理間 N. S.		期時×期間 N. S.			

表3. 肥料處理及採樣時期對柑葉鉀素含量之影響(烘乾物百分率)

Table 3. Effect of fertilizer treatment and time of sampling on the potassinm contents in citrus leaves (mean K % on oven-dry basis)

地點 Locality	處理 Treatment / 時期 Time	無氮區 PK	無磷區 NK	無鉀區 NP	三要素區 NPK	微量元素區 NPK+ Mn, Zn, Mg	平均 Averoge	L. S. D.
照門 Chawmen	三月 Mar.	0.81	0.67	0.67	0.77	0.73	0.732	
	五月 May	1.44	1.41	1.26	1.44	1.42	1.396	
	七月 July	1.34	1.31	1.12	1.20	1.20	1.237	處理間**
	九月 Sep.	1.20	1.04	0.90	0.98	0.98	1.020	5% 0.147
	十一月 Nov.	1.30	1.28	1.22	1.18	1.16	1.208	1% 0.202
	平均 Avcrage	1.221	1.142	1.016	1.116	1.098	1.118	
	L. S. D.		處理間** 5% 0.147 1% 0.202		處理×時期 N. S.			

大 坪 Taping	三 月 Mar.	0.68	0.47	0.48	0.52	0.44	0.521	時期間** 5% 0.218 1% 0.296
	五 月 May	1.62	1.25	1.22	1.41	1.20	1.342	
	七 月 July	1.50	0.98	0.94	1.06	0.99	1.097	
	九 月 Sep.	1.20	0.91	9.84	1.03	0.82	0.962	
	十一月 Nov.	1.30	0.84	0.80	0.89	0.66	0.898	
	平均 Average	1.262	0.892	0.858	0.984	0.824	0.664	
	L. S. D.		處理間** 5% 0.218 1% 0.296		處理×時期 N. S.			
員 林 Yuanlin	三 月 Mar.	1.13	1.46	1.14	1.41	1.12	1.255	時期間** 5% 0.212 1% 0.287
	五 月 May	1.98	1.91	1.86	1.94	1.88	1.916	
	七 月 July	1.38	1.22	1.18	1.19	1.24	1.243	
	九 月 Sep.	1.09	0.91	0.93	1.00	1.03	0.995	
	十一月 Nov.	1.08	0.90	0.86	1.00	0.93	0.995	
	平均 Average	1.333	1.284	1.196	1.310	1.241	1.272	
	L. S. D.		處理間* 5% 0.212		處理×期間 N. S.			

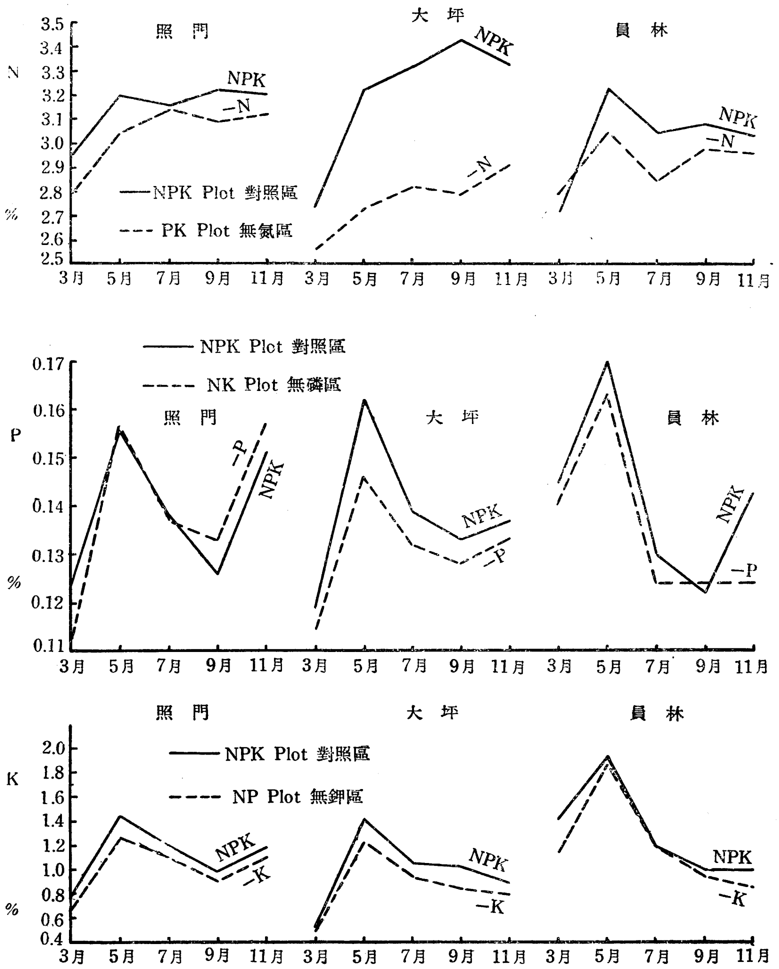


圖 1. 椪柑葉成分之季節的變化

Fig 1. Seasonal change of leaf composition in citrus Ponkan

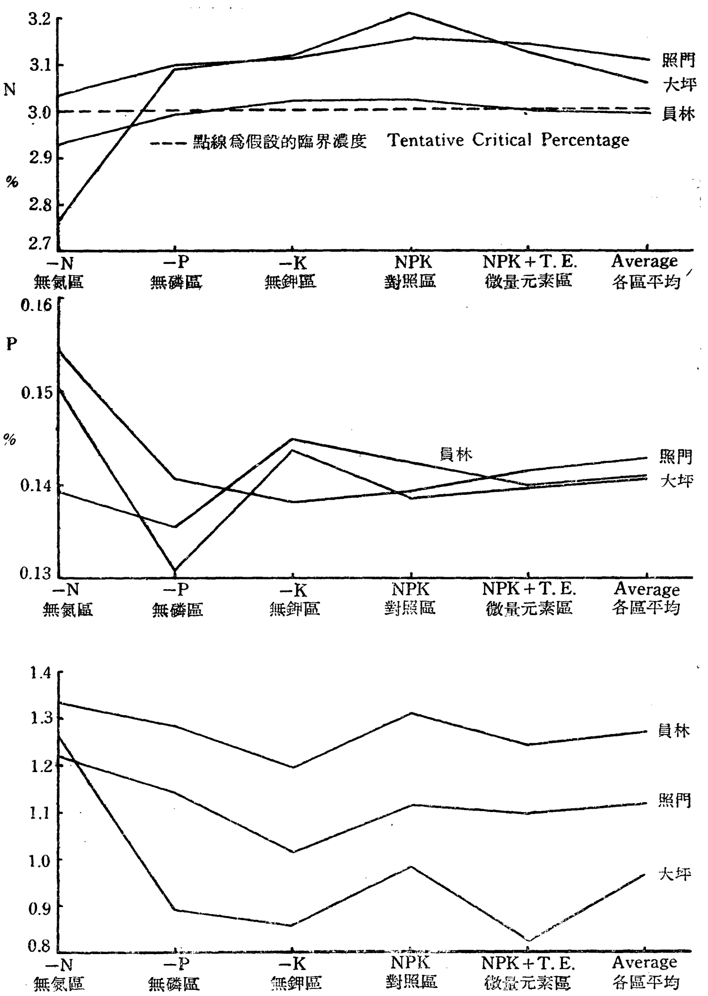


圖 2. 肥料處理對椪柑葉成分之影響(年平均%)

Fig. 2 Effect of fertilizer treatment on leaf compositions in Citrus Ponkan (yearly mean per cent)

由表 1 知無氮區柑葉N含量顯然因不施氮肥而略有降低。各地柑桔園之柑葉N含量除三月份外均為 3 %以上而無氮區則大都均低於此含量，雖然肥料試驗僅為第二年，現在各試驗地之無氮處理區皆呈較淡之葉色，可謂開始呈現缺氮之症徵。由現在結果推測，柑葉氮素之臨界濃度當在 3.0 %附近。為判定正確的臨界濃度，尚須繼續進行試驗之必要。

由表 2 可見，無磷區之柑葉P含量較對照區 (NPK區) 亦稍有降低，惟差異小，其統計結果各處理間P含量之差異所以顯著者，主要係由各時期無氮區之P含量比對照區為高所致。表 3 K含量之間亦有類似情形即除無鉀區之K含量比對照區稍為降低外，無氮區之K含量亦有顯著的增高，可見在缺氮情形下柑葉 PK 含量均有提高之傾向。三井氏[14]亦曾報告水稻在缺氮情形下可增加磷鉀吸收量 ，又微量要素區之K含量比對照區稍低如圖 2 因微量元素區為 NPK 之外另加 Mg, Mn, Zn, 而 Mg 以硫酸鎂每年每棵柑桔施用 1 磅，所以微量元素區之K含量比對照區稍低之原因似乎由 Mg 對K之拮抗作用 (Antagorism)[15]所致。

總之土壤中某種養分缺乏時除降低其葉中養分濃度外所施養分之不平衡 (Unbalanced fertilization) 亦可影響柑葉其他養分濃度之增減。因此利用葉分析診斷柑桔樹之營養狀態時不能單純僅由一種養分分析來判斷其養分之缺否而必須注重到各種養分間之平衡問題。

2. 季節與柑葉 NPK 成分之變化

由前表知柑葉中三要素含量均以三月爲最低，五月時急激增高。其後 NP 濃度變化較小，至於K濃度之變化，五月以後便漸漸減低，此係與葉齡，氣候及時期有關者，蓋三月所採者均爲前年留下之老葉並當果實收穫後果樹衰弱時期故濃度最低，五月所採者均爲春天新葉並值生長旺盛時期故無機養分之濃度較高，此種養分濃度之季節性變化以鉀素較大，磷較小，因此若要採用葉診斷時，須要確定季節，進行柑葉採樣。

3. 樣品葉數與柑葉成分之比較

五月於大坪柑桔施肥試驗地對照區 (NPK區) 之柑桔樹採取葉數 20, 40, 80 樣品三種以供分析，結果如表 4 ，由分析結果知各種樣品中 NPK 含量皆甚相似，變異係數甚小差異，可見葉數20之樣品已爲適當。

4. 採葉位置與葉成分之比較

五月在各試驗地，對三要素處理區之柑桔樹，由枝頂第 1, 2, 3 及 4 葉分別採取不同位置之柑葉樣本供爲分析，其結果列於表 5 ，變方分析結果 F 值不顯著，所以柑葉位置對其成分似無影響。

表 4. 採葉數與葉成分之比較

Table 4. Comparison of leaf composition due to number of leaves

成分 % Composition	重複 Replication / 採葉數 Number of leaves collected	1	2	3	4	平均 Average	變異係數 C. V.
N%	20	3.23	3.11	3.21	3.07	3.15	2.4%
	40	3.23	3.11	3.26	3.10	3.17	2.6%
	80	3.43	3.12	3.25	3.17	3.24	4.2%
P%	20	0.128	0.121	0.145	0.111	0.126	11.7%
	40	0.128	0.145	0.125	0.124	0.131	7.1%
	80	0.152	0.128	0.128	0.132	0.135	8.5%
K%	20	0.94	0.88	0.92	0.88	0.90	3.3%
	40	1.00	0.90	1.04	0.88	0.95	8.1%
	80	1.04	0.94	0.96	0.98	0.98	4.4%

〔註〕 五月於大坪柑桔園採取 Sampe collected from Taping orchard in May

表 5. 柑葉位置與葉成分之比較

Table 5. Comparison of leaf composition due to its position at citrus twigs

地點 Locality	位置 Position	氮 N%	磷 P%	鉀 K%
照門 Chawmen	第一葉 1 st leaf	3.14	0.150	1.85
	第二葉 2 nd leaf	3.20	0.159	1.76
	第三葉 3 rd leaf	3.14	0.157	1.68
	第四葉 4 th leaf	3.13	0.159	1.85

大　坪 Taping	第一葉 1 st leaf	2.96	0.143	1.39
	第二葉 2 nd leaf	3.16	0.148	1.40
	第三葉 3 rd leaf	3.09	0.147	1.49
	第四葉 4 th leaf	3.19	0.154	1.49
員　林 Yuanlin	第一葉 1 st leaf	3.00	0.143	1.38
	第二葉 2 nd leaf	3.01	0.140	1.32
	第三葉 3 rd leaf	3.03	0.142	1.32
	第四葉 4 th leaf	3.03	0.145	1.35

〔註〕 各成分%爲二重複之平均 Each composition perccnt is average of deplication

5. 施肥處理對柑桔收量之影響

施肥試驗本年爲第二年，各處理對柑桔收量之影響如表6以氮肥爲最大，鉀肥次之，磷肥及微量元素較小。柑桔爲多年生作物，各肥料處理若要顯著的影響其產量或引起各要素之缺乏症徵者必須繼續多年之試驗才能呈現，本年度柑葉分析爲其施肥後第二年之材料，施肥對柑葉成分雖稍有影響，但尙不大明顯因施肥尙未顯著影響到柑桔樹所以使用此材料未能確立各成分之限界濃度，但尙可供爲柑素營養診斷之基礎資料想將來有繼續研究之必要。

表6. 施肥對柑桔果實之影響 （公斤/每棵樹）

Table 6. Effect of fertilization on yield of citrus fruits (kg/tree)

處理 Treatment ＼ 地點 Locality	照門 Chawmen	大坪 Taping	員林 Yuanlin	平均 Mean	指數 Index
無氮區 (PK)	46.1	36.3	47.4	43.3	73
無磷區 (NK)	52.0	37.1	72.2	53.8	91
無鉀區 (NP)	47.9	39.5	60.7	49.4	84
三要素區 (NPK)	56.6	40.8	79.2	58.9	100
微量元素區 (NPK+T.E.)	68.7	49.4	73.5	63.9	108

四、摘　　要

1. 使用柑桔園施肥試驗地之柑桔樹爲材料進行葉分析做爲柑桔營養診斷之基礎研究。施肥試驗於1958年1月在臺灣主要椪柑產地，員林一地點，新埔二地點開始進行，肥料處理分爲無氮區，無磷區，無鉀區，三要素(對照)區，微量元素區等五處理。

2. 於1959年3月，5月，7月，9月，11月分別採取各試驗地處理區之柑葉，分析其氮、磷、鉀含量探究施肥與時期對柑葉成分之影響。

3. 柑葉N. P. K含量隨季節之不同其變化甚大。五月各養分之濃度爲最高，此爲春天展開之新葉，以後各養分漸漸減低至翌年三月爲最低，蓋三月所採者均爲前年留下之老葉。

4. 各試驗地柑葉之N含量，在無氮區平均爲2.76%～3.03%而對照區爲3.02%～3.21%。柑葉氮之臨界濃度推測爲3.0%附近。

5. P含量在無磷區爲0.131%～0.140%而對照區爲0.138%～0.142%，其差異不大，但無氮區之P含量比對照區者顯著的增高，其差異達到統計的顯著標準。

6. K含量在無鉀區爲0.86%～1.19%而對照區爲0.98%～1.31%，類似P含量情形，無氮區之K含量亦有顯著的增高，所以柑桔樹在缺氮情形下似有增加吸收磷、鉀之傾向。NP 含量在各柑

桔園間之差異較少，但K含量其差異甚大，則平均K含量在照門爲 1.118 %，大坪 0.964 %，員林 1.272% 。

7. 檢討採葉位置卽由枝頂第 1, 2, 3, 4 葉及樣本採葉數20葉，40葉，80葉與葉成分之關係，其結果表示採葉位置及葉數對葉成分不大有影響。

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STUDY ON LEAF ANALYSIS AS A MEANS OF DIAGNOSING NUTRITIONAL STATUS OF CITRUS PLANTS

by

T. F. CHIU & S. M. LIN

SUMMARY

1. Leaf analysis was conducted as a means of diagnosing nutritional status using Citrus Ponkan trees on the fertilizer experiment orchards as materials. The fertilizer experiments have been started since January, 1958 at one lacality in Yuanlin and two localities in Hsinpu, with five treatments layout, i. e. a) No N plot (PK), b) No P plot (NK), c) No K plot (NP), d) NPK plot (Check), e) Trace Elements plot (NPK+Mg, Mn, Zn).

2. Leaf samples were collected at each experimental plot in March, May, July, September and November 1959 respectively, then N, P, and K were analyzed in order to investigate the effect of fertilization and time of sampling on leaf compositions.

3. All these citrus trees had generally the highest leaf contonts of N, P and K in

May which is at the early stage of foliation and these contents decreased gradually thereafter. In March next year, it became the lowest contents which is attributed to old age of leaves.

4. N contents in citrus leaves at each locality were 2.76%-3.03% on average in the no N plot, while there were 3.02%-3.21% in the check plot. The critical percentage of nitrogen in Citrus Ponkan leaves was considered at about 3.0%.

5. P contents in the no P plot were 0.131%-0.140% and there were 0.138%-0.142% in the check Plot. The differerence of P contents between these two plots was so small but it increased greatly at the no N plot. P contents in the no N plot was significantly higher than that in the check plot.

6. K contents in the no K plot were 0.86%-1.19% and there were 0.98%-1.31% in the check plot. K contents in the no N plot also showed apparently higher, so that nitrogen deficiency would be considered to promote the accumulation of P and K in citrus leaves. It was also found that the difference of K contents in leaves among those three orchards was quite large, but it was small in the case of N and P.

7. The position of leaves at citrus twigs and number of leaves sampled in this experiment was seemed to be little influennce on leaf compositions.

龍 眼 果 實 脫 水 試 驗

陳 景 福　黃 本 田　李 彬 書

龍眼爲亞熱帶經濟果樹之一。以臺灣而言，歷年產量皆居全省果產之第四位，果肉鮮美，但不耐久藏，在豐產之年，因產量激增，供過於求，價格下跌，則果農經濟勢將遭受損失，如予以適當之脫水處理，使果品得以不變質不變味而更延長其壽命 (Shelf life)，以增加果實之商品價值；或使以出口外銷以換取外滙，則於果農經濟至有裨益。

以高雄縣大崗山、大樹鄉及臺南一帶所產之新鮮龍眼爲原料，計有鈕子眼、福眼種及晚生種三個品種，利用省農業試驗所鳳山熱帶園藝試驗分所園產加工實驗工廠之小型廂式脫水機 (Cabinet dehydrater) 及熱空氣流動乾燥法以作脫水試驗。

脫水試驗，分爲全果脫水與剝取果肉脫水兩種。前者全不用蒸汽殺菁(Steam blanching)，後者分爲蒸汽殺菁與不用蒸汽殺菁 (Non-steam blanching) 兩種。玆將不同品種之龍眼脫水情形，簡記如次：

表一　鈕子眼種龍眼脫水情形記載

Table 1. Records of Dehydration of Niu Tzu Yen Longan

原料別 Raw Materials	製造日期 Manufacturing date 年 月 日	龍眼重 Weight of Longan 公斤(kg.)	殺菁時間 Time of Steam Blanching 分鐘(min.)	加糖量 Percent of Cane sugar added %	脫水溫度 Dehydrating temperature °F	脫水時間 Time of Dehydration 小時(hr.)	成品重 Weight of Products 公斤(kg.)	乾燥率 Drying ratio %
全果 Whole fruit	49. 7. 29	2.0	—	—	170-180	17	0.72	36.0
全果 Whole fruit	49. 8. 5	1.15	—	—	170-180	20	0.41	35.6

註：鈕子眼種龍眼果實較小，且果肉薄，不適於剝取果肉以供脫水用，故未作果實脫水試驗。

Remarks: The fruit of this variety is rather smaller than Fu yen variety and the flesh is thin too. Really it is unsuitable for the dehydration of flesh only, so we did not do the Experiment of flesh dehydration.

表二　福眼種龍眼脫水情形記載

Table 2. Records of Dehydration of Fu Yen Chung Longan

原料別 Raw Materials	製造日期 Manufacturing date 年 月 日	龍眼重 Weight of Longan 公斤(kg.)	殺菁時間 Time of Steam Blanching 分鐘(min.)	加糖量 Percent of Cane sugar added %	脫水溫度 Dehydrating temperature °F	脫水時間 Time of Dehydration 小時(hr.)	成品重 Weight of products 公斤(kg.)	乾燥率 Drying ratio %
全果 Whole fruit	49. 7. 23	1.35	—	—	170-180	24	0.405	30.0
果肉 Fruit flesh	49. 7. 13	0.93	—	—	150-160	9	0.09	9.7
果肉 Fruit flesh	49. 7. 19	1.15	5	—	150-160	9	0.11	9.56
果肉 Fruit flesh	49. 7. 23	1.50	3	—	150-160	9	0.155	10.30
果肉 Fruit flesh	49. 8. 15	2.72	3	20	150-160	9	0.355	13.05

果 肉 Fruit flesh	49. 8. 22	1.48	3	15	150-160	9	0.18	12.20
果 肉 Fruit flesh	49. 8. 23	1.48	3	20	150-160	9	0.21	14.20

表三 晚生種龍眼脫水情形記載

Table 3. Records of Dehydration of Wan Sheng Chung Longan

原料別 Raw Materials	製造日期 Manufacturing date 年 月 日	龍眼重 Weight of Longan 公斤(kg.)	殺菁時間 Time of Steam Blanching 分鐘(min.)	加糖量 Percent of Cane sugar added %	脫水溫度 Dehydrating temperature °F	脫水時間 Time of Dehydration 小時(hr.)	成品重 Weight of Products 公斤(kg.)	乾燥率 Drying ratio %
果 肉 Fruit flesh	49. 9. 14	3.00	3	20	150-160	9	0.39	13.00
果 肉 Fruit flesh	49. 9. 15	3.00	3	15	150-160	9	0.375	12.50

將以上各品種之龍眼脫水製品分別裝入攜帶罐(即平五號罐)中，經貯藏三個月後，開罐檢查結果如次：

表四 各品種龍眼脫水製品之檢查結果

Table 4. Different Dehydrated Longan product of Various varieties which packed in Cans after inspection

樣品代號 Sample No.	品種別 Varieties	原料別 Raw materials	製造日期 Manufacturing date 年 月 日	開罐檢查結果 Results of inspection of the cans
1.	福眼種 Fu Yen Chung	全 果 Whole fruit	49. 7. 23	果肉棕黑色，透明，微甜，風味良好。 The flesh color is brownish black, transparent, slightly sweetness, its flavor is good.
2.	鈕子眼 Niu Tzu Yen	全 果 Whole fruit	49. 7. 29	果肉棕黑色，果肉薄，風味良好。 The flesh color is also brownish black but the flesh is thin. It has a good flavor too.
3.	鈕子眼 Niu Tzu Yen	全 果 Whole fruit	49. 8. 5	果肉薄而乾，色呈棕黑，風味尚佳。 The flesh color is also brownish black, its flesh is thin and hard, the flavor is fair.
4.	福眼種 Fu Yen Chung	果 肉 Fruit flesh	49. 7. 13	果肉棕色，微甜，風味佳良。 The flesh color is brown, slightly sweetness, it has a delicious flavor.
5.	福眼種 Fu Yen Chung	果 肉 Fruit flesh	49. 7. 19	因殺菁時間稍長，果肉蒸爛，色變灰褐，不甜，風味劣。 For the blanching time is longer than the ordinary treatment, so the flesh is broken like the pulp, the color turned to brownish gray, no sweetness, It is not palatable.
6.	福眼種 Fu Yen Chung	果 肉 Fruit flesh	49. 7. 23	成品顏色甚佳，風味優良，惟不過甜。 The flesh color is very good, though it is delicate, but not too sweetness.
7.	福眼種 Fu Yen Chung	果 肉 Fruit flesh	49. 8. 15	顏色風味俱佳，甜度適當，甚爲可口。 Both the color and flavor are very good with a increasing of palatability.
8.	福眼種 Fu Yen Chung	果 肉 Fruit flesh	49. 8. 22	顏色風味皆好，味甜可口。 Both the color and flavor are also very good, it is palatable and sweetness.

9.	福眼種 Fu Yen Chung	果肉 Fruit flesh	49. 8.23	色味均佳，甜度適當，甚爲可口。 Both the color and flavor are good with an optimum sweetness and delicious taste.
10.	晚生種 Wan Sheng Chung	果肉 Fruit flesh	49. 9.14	色黃而有光澤，味甜可口。 The color of the product is yellow with a lustrous, it is sweetness and palatable.
11.	晚生種 Wan Sheng Chung	果肉 Fruit flesh	49. 9.15	色黃且有光澤，甜度適當，風味良好。 Its color is also yellow with a glossy, it is sweetness and delicacy too.

上列各種龍眼脫水製品，經開罐檢查後，選出一批顏色風味均較佳良之 No. 1, No. 2, No. 4, No. 6, No. 7, No. 8 及 No. 11 等製品，於本年十月一日及四日兩天，邀請鳳山熱帶園藝試驗分所果樹組及製造組同事九人在加工廠作風味品評，茲將品評結果分誌於次：

表五　龍眼脫水製品風味品質之品評記錄

Table 5. Critical records of Color, flavor, taste and quality of Dehydrated Longan

A. 全果脫水製品

Dehydrated products of whole fruit

樣品代號 Sample No.	品種別 Varieties	原料別 Raw materials	色澤 Color	風味 Flavor & Taste	品質 Quality	外觀 Appearance	總計 Total	等第 Grade
1.	福眼種 Fu Yen Chung	全果 Whole fruit	20.66	22.55	21.67	22.00	86.88	1
2.	鈕子眼 Niu Tzu Yen	全果 Whole fruit	19.55	21.78	20.33	19.78	81.43	2
備註 Remarks	1. 以上各項目之滿分各爲25，總計爲100. The points of the above items is 25 each, but the grand total is 100. 2. 此爲經分所同事九人品評記分統計後之平均結果。 All the above data are the average value of organoleptical test by 9 colleagues in our experiment station.							

B. 果肉脫水製品

Dehydrated products of fruit flesh

樣品代號 Sample No.	品種別 Varieties	原料別 Raw materials	色澤 Color	風味 Flavor & Taste	品質 Quality	外觀 Appearance	總計 Total	等第 Grade
4.	福眼種 Fu Yen Chung	果肉 Fruit flesh	19.43	22.30	23.29	19.57	84.59	2
6.	福眼種 Fu Yen Chung	果肉 Fruit flesh	19.29	22.00	22.14	19.57	83.00	3
7.	福眼種 Fu Yen Chung	果肉 Fruit flesh	20.43	21.14	20.43	20.43	82.43	4

8.	福眼種 Fu Yen Chung	果肉 Fruit flesh	20.14	19.71	21.29	20.30	81.44	5
11.	晚生種 Wan Sheng Chung	果肉 Fruit flesh	22.71	20.14	20.00	23.14	85.99	1

附註 Remarks

1. 以上各項目之滿分各爲25，總分爲100.
   The full points of the above items is 25 each and the grand total is 100.
2. 此爲經分所同事九人品評記分統計後之平均結果。
   All the above data are the mean value of organoleptical test by nine colleagues in our experiment station.

最後將貯藏三個月以後之龍眼果肉脫水製品五種，分析其水分及全糖分。玆誌分析結果如次：

表六　龍眼果肉脫水製品之成分分析

Table 6. Analysis of Dehydrated Longan flesh

分析項目 Items ＼ 樣品號次 Sample No.	No. 4	No. 6	No. 7	No. 8	No. 11
水分(%) Moisture	13.84	15.10	11.20	11.92	11.50
全糖分(%) Total Sugar	22.58	21.53	35.94	25.20	23.63
附註 Remarks	全果脫水製品因含水分較多，不易保存較長時間，除少數幾袋品質良好者，供品評之用外，已無好的製品可供分析。The dehydrated products of Longan whole fruit Comprises more moisture, so it can not be stored for a longer time. Except some polyethylene bags of good quality have been used for organoleptical test, but at present no good products can be employed for analysis.				

綜合以上試驗結果，可得結論數點如下：

1. 龍眼脫水品種，以福眼種爲佳。

2. 龍眼脫水製品，經開罐檢查並由分所同事九人品評之結果，全果脫水以 No. 2 製品爲佳，果肉脫水則以 No. 11 製品爲優。

3. 查 No. 2製品係在170°～180°F. 溫度脫水24小時；No. 11製品爲果肉先行殺菁(blanching) 3分鐘，加砂糖15～20%，於150°～160°F. 溫度脫水 9 小時，然後裝盛於鐵罐中。

4. 依據分析結果，龍眼果肉脫水製品之水分量，以 No. 7 爲低 (11.20%)，但全糖分量高(35.94%)；No. 11製品之水分量爲 11.50%，雖次於 No. 7 製品，但糖分量適中(23.63%)所以甜度適當，風味良好。

5. 裝盛龍眼全果脫水製品之容器，以用塑膠袋 (Polyethylene bag) 爲佳；裝盛龍眼果肉脫水製品，以用塗敷釉質的空鐵罐 (Enamel lined cans) 爲宜。

6. 本試驗所用之熱空氣流動乾燥法及小型廂式脫水機構造圖，均分別刊載於臺灣省農業試驗所41年年報第260～261頁及臺灣糖業公司屏東總廠蔗作改良場48～49年期研究試驗簡報第 139 頁，故此處不再縷述。

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EXPERIMENT ON THE DEHYDRATION OF LONGAN

by

C. F. CHEN, P. T. WONG & P. S. LEE

SUMMARY

Longan (Euphoria longana Lam.) is one of the economic fruit trees in the subtropical zone. In Taiwan, its yearly production occupied the fourth rank among the annual total fruit yields. The fruit flesh are delicate and palatable, but it cannot be stored for a longer time. During the harvesting season, though its production increased suddenly but low in price, thus it will be influencing the economics of the farmers-in-fruit. For this reason, the preservation of longan by dehydration is necessary. It is concluded that the dehydrated longan will not alter the quality and flavor. Futhermore, it will be elongated the shelf life of longan product for exportation.

Three varieties of longan are used as the raw materials for dehydration. Viz., Fu Yen Chung, Niu Tzu Yen and Wan Sheng Chung. The dehydration experiment was carried out at the pilot plant of Fengshan Horticulture Experiment Station on June, 1960 and ended on October, 1960. The cabinet dehydrater is employed for dehydration, while the raw materials are dried in a current of heated air in the dehydrater. The experimental results may be summarized as follows:

1. Among the three varieties, Fu Yen Chung is the best one for making the dehydrated longan.

2. Both the inspection of canned longan dehydrated products and the organoleptical tests were performed. In whole fruit dehydration, the product No. 2 is superior than the other one; while in the fruit flesh dehydration only, the product No. 11 is the better than the other four dehydrated products.

3. The optimum drying temperature and time for dehydrating the whole fruit are considered to be most favorable between 170°–180°F. for 24 hours, whereas the operation of dehydrating the fruit flesh is slightly different, the flesh is first steam blanching for 3 minutes, then added the cane sugar 15–20% (based on the weight of fresh flesh), finally dehydrated under the temperature 150°–160°F. for 9 hours and then packed with enamel lined cans.

4. According to the analytical data, though the moisture of the dehydrated product No. 7 is so low (11.20%), but the sugar content (35.94%) is higher than others; while the product No. 11, however, both the moisture content as well as the sugar content are 11.50% and 23.63% respectively. Hence it is palatable and the flavor is also good.

5. The best longan dehydrated product has been obtained when the enamel lined cans are used for packing.

稻菌核性病害之研究

第一報 施肥、品種對于菌核性病害之關係

陳其昌 簡錦忠 黃添福

一、緒　　言

稻菌核性病害在本省自很久以前即已發現，至今已分佈各稻栽培地域，但其發生情形不如稻熱病之猖獗，故亦不若稻熱病之受重視。在本省關於本病害之記載最初澤田氏[9] (1911) 發現樟大粒白絹病菌 (Hypochnus sasakii Shirai) 亦可以寄生於稻。同氏[10] (1919) 又記載 Hypochnus centrifungus (Lev.) Tul. 及 Hy. sasakii Shirai 2種均可寄生於稻，同氏[11] (1921) 再記載 Sclerotium oryzae Catt 及 S. oryzae-sativae Saw. sp. nor. 2種，後者係新發見之新種，又同氏[12] (1959) 之遺稿記載 Sclerotium fumigatum Sacc; S. oryzae Catt; Helminthosporium Sigmoideum Cav. var. irregulare Craley et Tullis 等3種，其中2種係新發見，即同氏自1911～1959年記載計6種。小川氏[4] (1937) 記載本省稻作菌核性病害7種，而且訂正一部份之學名，即①稻紋枯病 (大粒白絹病)＝Corticium Sasakii (Shirai) Matsumoto. (Hypochnus sasakii Shirai); ②稻小黑菌核病(小粒菌核病，稈腐小黑菌核病，櫻井4號菌核病)＝Helminthosporium Sigmoideum Cav. var irregulare Crally; ③稻小粒白絹病＝Corticium centrifugus (Lev.) Bres. (Hypochnus centrifugus Tul.); ④稻小球菌核病(小菌核病，櫻井3號菌核病)＝Leptoshaeria saluinii Catt. (Helminthosporium sigmoideum Cav., Sclerotium oryzae Catt.); ⑤稻球形菌核病(球狀菌核病，櫻井2號菌核病)＝Sclerotium sphaeroides Nakata; ⑥稻褐色菌核病＝Sclerotium Oryzae-sativae Saw.; ⑦稻灰色菌核病＝Sclerotium fumigatum Nakata 等7種。再者松本氏[7] (1949) 記述9種菌核性病害，除前記小川氏記載之7種以外，亦增加稻赤色菌核病＝Rhizoctonia oryzae Ryher et Gooch 及稻褐色小粒菌核病＝Sclerotium oryzicola Nakata et Kawamura 等2種。該2種菌核病係著者(陳)在臺北自盒栽稻苗分離所得，其後赤色菌核病係自埔里之水稻 (著者陳、黃) 及自臺南之甘蔗 (著者陳) 分離所得者，其寄生性極强，故將來應特別注意此病害。此外關於本病病原菌之生理生態及防治法由小川氏[5] (1941) 有詳細的記述，其後松本氏[7,6] (1949, 1953)，陳氏[1] (1951) 亦有記述關於此項之報告。

但因本省位於亞熱帶，氣候對於稻菌核性病害之病原菌，易於促進其生長與繁殖，近年來增加施肥量，同時亦有增加被害面積之傾向，當中稻紋枯病在高溫 (30°C) 之下較易繁殖 (松本氏[6] 1953)。最近本省對稻螟蟲，稻熱病等之防治方法有極顯著的進步，對稻作慣行給很大的革新，但對菌核性病害尚缺詳細之研究，著者等鑑於此，自幾年前開始從事本項研究，茲將所得結果介紹如次，俾供今後之參考。

二、試驗結果

1. 施肥對於稻品種抗紋枯病之影響

本試驗爲檢討氮肥施用量不同時，溫熱兩帶原產稻對紋枯病罹病程度之變化。氮肥係施用硫酸錏 (N. 20%)，每10公畝施用量爲硫酸錏40公斤 (標準量) 或 160 公斤 (四倍肥) 或無施氮肥等三處理，於1947年第1期稻作擧行。茲列擧其結果如表一：

表一：施肥對於稻品種抗紋枯病之影響

品種名	氮施用量	株高 (cm)	穗數	紋枯病罹病率 (%)	產量 (kg/ha) 純穀	產量 (kg/ha) 粃	生育期 出穗期 (月 日)	生育期 成熟期 (月 日)
神力	0 N	92.7	11.1	1.7	3,247	104	5. 31	6. 28
	1 N	97.6	12.9	9.9	4,199	144	5. 28	6. 25
	4 N	110.9	16.1	49.1	1,698	462	5. 30	6. 28
初光	0 N	75.8	6.4	0.0	457	96	5. 31	6. 28
	1 N	84.4	12.7	16.7	651	260	5. 31	6. 28
	4 N	95.5	19.5	54.2	996	272	5. 31	6. 28
陸羽 120 號	0 N	93.5	6.9	12.9	409	—	5. 29	6. 28
	1 N	101.5	11.6	7.4	625	366	5. 29	6. 30
	4 N	102.2	12.5	13.4	668	34	5. 29	6. 30
凱旋	0 N	93.3	7.2	15.8	2,120	188	6. 4	7. 15
	1 N	103.1	10.8	25.0	3,349	178	6. 3	7. 15
	4 N	114.1	13.3	44.4	2,122	424	6. 9	7. 10
浦三	0 N	95.6	8.7	16.6	3,269	171	6. 5	7. 15
	1 N	108.3	9.7	0.0	4,188	466	6. 5	7. 15
	4 N	113.7	10.4	22.2	2,905	717	6. 7	7. 20
美濃糯 1 號	0 N	98.7	7.3	21.9	3,317	107	6. 8	7. 16
	1 N	115.4	9.9	22.5	3,798	142	6. 7	7. 16
	4 N	119 8	13.0	20.5	3,468	361	6. 9	7. 19
臺中特 6 號	0 N	102.3	10.0	5.0	3,301	72	6. 10	7. 17
	1 N	110.9	11.2	11.1	3,903	89	6. 10	7. 17
	4 N	116.0	12.6	58.2	2,241	353	6. 12	7. 19
臺中 150 號	0 N	92.1	10.1	4.2	3,597	88	6. 17	7. 18
	1 N	102.7	12.9	4.0	4,108	146	6. 16	7. 19
	4 N	112.2	18.3	19.4	2,993	216	6. 25	7. 25
烏尖	0 N	100.8	10.0	2.9	3,486	33	6. 29	7. 22
	1 N	103.8	14.3	0.0	3,486	123	6. 27	7. 22
	4 N	110.3	16.4	5.8	3,356	247	6. 28	7. 24
臺農 47 號	0 N	94.7	10.0	7.5	3,756	88	6. 20	7. 20
	1 N	102.6	14.3	4.1	4,266	164	6. 23	7. 20
	4 N	106.3	16.4	36.5	2,993	293	6. 25	7. 28
臺中 159 號	0 N	104.7	8.1	1.4	4,193	95	6. 9	7. 14
	1 N	120.0	8.8	5.5	4,841	191	6. 10	7. 15
	4 N	127.7	12.2	16.0	2,743	302	6. 18	7. 16
蟻公包	0 N	112.0	10.3	0.0	3,351	111	6. 14	7. 16
	1 N	123.4	11.3	3.3	3,961	94	6. 13	7. 17
	4 N	124.1	13.4	32.0	3,194	303	6. 20	7. 20
大毛稻	0 N	67.9	3.7	0.0	315	—	5. 25	6. 28
	1 N	73.4	3.6	16.7	274	—	5. 25	6. 28
	4 N	76.6	5.2	8.0	411	—	5. 25	6, 29
金山	0 N	83.3	8.2	3.2	1,275	140	6. 4	7. 4
	1 N	91.4	10.0	3.6	1,414	31	6. 4	7. 4
	4 N	88.6	16.2	64.3	1,855	—	6. 4	7. 6
蘇州 34 號	0 N	94.1	12.6	2.9	3,709	105	6. 12	7. 23
	1 N	115.3	18.6	9.4	3,703	169	6. 13	7. 22
	4 N	96.1	18.1	28.6	2,218	735	6. 14	7. 24
福州大旱	0 N	100.5	9.8	2.8	3,814	59	6. 18	7. 17
	1 N	115.7	11.0	13.5	3,638	111	6. 15	7. 18
	4 N	106.5	14.5	18.1	2,347	252	6. 28	7. 22
團谷草	0 N	114.6	11.3	20.0	3,964	94	6. 12	7. 18
	1 N	123.6	13.0	0.0	4,559	210	9. 10	7. 18
	4 N	122.0	12.8	66.7	1,907	240	6. 5	7. 10
Bomba	0 N	119.7	5.9	3.3	2,407	49	6. 12	7. 7
	1 N	127.8	8.9	17.2	3,162	85	6. 11	7. 7
	4 N	110.8	10.5	67.6	1,232	86	6. 18	7. 9

Louisiana	0 N	101.7	9.1	13.9	1,936	883	6. 21	7. 16
	1 N	102.1	10.4	16.4	2,881	240	6. 18	7. 16
	4 N	111.1	10.9	17.8	229	158	7. 7	7. 21
Blue Rose	0 N	117.5	7.7	0.0	2,582	106	6. 12	7. 28
	1 N	125.3	8.6	1.9	2,688	158	6. 12	7. 28
	4 N	107.3	10.5	17.5	1,361	470	7. 1	7. 24

由上表可知多數稻種對於紋枯病之被害莖率，隨氮肥施用量而遞增，但當中本省在來稻(烏尖)之被害莖率最低，又生育狀況卽稻株高及穗數亦隨氮肥之增加而其生育狀況較佳，不過產量卽一般氮肥施用四倍區最不良，標準肥量區之產量最佳。

據池野，山田氏[2] (1953) 試驗結果，無鉀區及氮肥多量區之發病最多，又氮肥區內，如施用硫酸根肥料區比無硫酸根肥料區之發病較多，又根部之腐敗亦爲激烈。又尾崎、岩瀨、都築氏[8] (1953)報告，土壤如缺乏氮肥及燐肥或多施鉀肥時紋枯病之發生較少。橫木氏[13] (1933) 認爲施用人糞尿區及氮肥多量區之發病最多，無肥料區及鉀肥多量區之發病爲少，故三要素中氮肥與紋枯病發病之關係最密接。

2. 稻品種對於紋枯病及小黑菌核病之抵抗性檢定

本試驗係廣集本省所育成之稻品種，於田間栽植施用多量肥料（每10公畝施肥量爲硫酸錏80公斤，過燐酸石灰30公斤・硫酸鉀10公斤）及排水管理，在自然環境下觀察各品種之罹病情形(表二)及在田間施用標準肥料（每10公畝施肥量爲硫酸錏40公斤，過燐酸石灰30公斤，硫酸鉀10公斤）舉行人工接種病原而後觀察各品種間之罹病狀況。人工接種病原係培養於稻藁培養基，放置於28°C定溫箱，經過二星期後等菌絲長滿稻藁培養基後，將取出稻藁夾於稻叢中，然後於稻成熟期調查各品種之罹病莖率(表三)。

表二：稻品種對於紋枯病及小黑菌核病之抵抗性檢定(1952)

品種名	紋枯病				小黑菌核病	
	第1期作		第2期作		第1期作	
	發病率	抗病位次	發病率	抗病位次	發病率	抗病位次
	%		%		%	
白米粉	—	—	—	—	53.27	20
光復1號	91.70	18	46.67	10	58.84	31
高雄27號	91.53	17	45.56	8	69.22	42
高雄22號	85.79	4	71.11	42	59.88	33
高雄18號	92.67	24	50.00	16	60.83	34
苗栗3號	94.20	38	44.44	7	58.61	30
農育1804號	93.31	29	58.89	30	46.17	10
新農育24號	90.57	15	55.56	25	50.05	17
新農育14號	93.72	36	70.00	40	38.27	3
新農育76號	90.33	14	58.89	31	56.16	24
高雄25號	90 27	13	53.33	22	49.94	16
農育1805號	93.23	28	51.11	18	61.72	36
臺中153號	93.67	35	52.22	20	66.44	40
嘉南8號	86.53	5	53.33	23	57.33	27
農育1830號	92.80	25	47.78	11	66.11	39
吉神×Banda	89.20	10	32.22	1	47.88	12
新農育74號	89.43	11	45.56	9	43.44	7
臺中育34號	95.00	43	61.11	33	68.00	41

苗栗 13 號	92.63	22	57.78	27	41.00	4
新農育 17 號	88.65	8	65.56	38	48.50	14
苗栗 26 號	93.60	34	40.00	3	71.33	44
新農育 73 號	86.62	6	78.89	44	63.55	37
新農育 31 號	93.40	31	40.00	4	51.00	18
高雄 10 號	87.73	7	58.89	29	70.83	43
臺中育 43 號	92.33	21	50.00	17	58.44	29
農育 1808 號	93.21	27	41.11	6	56.55	26
新農育 19 號	92.87	26	71.11	43	48.05	13
光復 401 號	93.53	32	63.33	35	53.61	21
南育 508 號	92.61	23	58.89	32	42.38	5
臺中育 39 號	89.73	12	62.22	34	49.72	15
南育 485 號	94.86	42	64.44	36	65.16	38
臺中育 54 號	94.80	41	51.11	19	52.66	19
新農育 26 號	94.53	40	70.00	41	59.00	32
新竹 50 號	92.00	19	67.78	39	43.33	6
新農育 41 號	91.44	16	53.33	24	60.94	35
高雄 24 號	83.20	2	48.89	12	55.11	22
臺中 65 號	88.67	9	57.78	28	74.11	45
臺北 8 號	93.32	30	37.78	2	57.66	28
新農育 34 號	94.38	39	48.89	13	55.83	23
Doreo×臺北 8 號	81.12	1	40.00	5	47.83	8
嘉南 14 號	83.97	3	48.89	15	47.72	11
臺中 122 號	94.20	37	52.22	21	56.38	25
臺中 117 號	93.60	33	48.89	14	32.72	1
臺中育 48 號	92.18	20	55.56	26	45.33	9
崑山五香粳	—	—	64.44	37	36.50	2

表三：稻品種對於紋枯病及小黑菌核病之抵抗性檢定(1955)

品種名	病害名	被害率 (%)	產量 (gr./20hill)		
			乾燥重量	精選重量	粃重量
苗栗34號	紋枯病	23.3	360.0	340.0	20.0
	CK 紋枯病	53.2	407.5	387.5	20.0
	CK 小黑菌核病	13.4			
	小黑菌核病	25.0	402.0	367.5	34.5
嘉義晚2號	紋枯病	21.5	351.5	337.5	14.0
	CK 紋枯病	27.5	385.0	357.5	27.5
	CK 小黑菌核病	4.0			
	小黑菌核病	21.5	387.5	370.0	17.5
臺中糯46號	紋枯病	4.0	367.5	357.5	10.0
	CK 紋枯病	27.8	345.0	325.0	20.0
	CK 小黑菌核病	36.5			
	小黑菌核病	5.0	330.0	317.5	12.5
臺北8號	紋枯病	24.5	39.0	375.0	15.0
	CK 紋枯病	10.8	382.5	360.0	22.5
	CK 小黑菌核病	30.5			
	小黑菌核病	38.0	407.5	377.5	30.0

嘉南15號	紋枯病	32.0	365.0	330.0	35.0
	CK {紋枯病 小黑菌核病	10.8 8.6	385.0	350.0	35.0
	小黑菌核病	15.0	380.0	352.5	27.5
臺中65號	紋枯病	22.6	355.0	335.0	20.0
	CK {紋枯病 小黑菌核病	13.2 20.0	380.0	360.0	20.0
	小黑菌核病	13.5	340.0	317.5	22.5
農育1830號	紋枯病	29.2	415.0	399.5	22.5
	CK {紋枯病 小黑菌核病	28.6 43.5	437.5	427.5	10.0
	小黑菌核病	23.5	415.0	387.5	27.5
光復401號	紋枯病	26.9	397.5	392.5	5.0
	CK {紋枯病 小黑菌核病	11.3 22.0	400.5	380.0	22.5
	小黑菌核病	27.5	372.5	357.5	15.0
臺中162號	紋枯病	42.3	385.0	350.0	35.0
	CK {紋枯病 小黑菌核病	9.9 27.5	405.0	370.0	35.0
	小黑菌核病	42.0	387.5	365.0	22.5
農育1804號	紋枯病	24.2	375.0	362.5	12.5
	CK {紋枯病 小黑菌核病	47.0 47.0	367.5	350.0	17.5
	小黑菌核病	27.5	395.0	325.0	70.0
臺農45號	紋枯病	28.3	377.5	355.0	22.5
	CK {紋枯病 小黑菌核病	9.5 5.4	385.0	362.5	22.5
	小黑菌核病	30.0	405.0	390.0	15.0
農育1805號	紋枯病	28.3	412.5	397.5	15.0
	CK {紋枯病 小黑菌核病	20.1 17.0	415.0	395.0	20.0
	小黑菌核病	46.0	405.0	380.0	25.0
旭	紋枯病	25.8	360.0	340.0	20.0
	CK {紋枯病 小黑菌核病	28.9 30.5	400.0	375.0	25.0
	小黑菌核病	43.5	362.5	332.5	30.0
臺中153號	紋枯病	42.0	355.0	330.0	25.0
	CK {紋枯病 小黑菌核病	20.3 4.0	412.5	392.5	20.0
	小黑菌核病	24.0	407.5	390.0	17.5
嘉南2號	紋枯病	43.5	380.5	357.5	25.0
	CK {紋枯病 小黑菌核病	12.0 13.5	382.5	355.0	27.5
	小黑菌核病	7.5	365.0	355.0	10.0
高雄18號	紋枯病	18.2	360.0	342.5	17.5
	CK {紋枯病 小黑菌核病	10.9 34.0	415.0	405.0	10.0
	小黑菌核病	30.5	347.5	337.5	10.0
臺中154號	紋枯病	29.7	365.0	345.0	20.0
	CK {紋枯病 小黑菌核病	5.0 13.0	402.5	380.0	22.5
	小黑菌核病	20.5	375.0	355.0	20.5
臺中150號	紋枯病	49.2	362.5	340.0	27.5
	CK {紋枯病 小黑菌核病	4.0 14.0	387.5	377.5	10.0
	小黑菌核病	17.5	375.0	355.0	20.0
光復1號	紋枯病	37.7	355.0	332.5	37.5
	CK {紋枯病 小黑菌核病	35.5 36.0	367.5	360.0	7.5
	小黑菌核病	26.0	330.0	302·5	27.5
新竹4號	紋枯病	45.7	310.0	285.0	25.0
	CK {紋枯病 小黑菌核病	14.7 22·0	342.5	285.0	24.0
	小黑菌核病	8.5	305.0	285.0	20.0

苗栗36號	紋枯病	42.5	407.0	385.0	22.5
	CK 紋枯病	43.3	417.5	400.0	17.5
	CK 小黑菌核病	19.0			
	小黑菌核病	47.5	382.5	370.0	12.5
嘉南8號	紋枯病	17.2	402.5	385.0	17.5
	CK 紋枯病	40.1	425.0	405.0	20.0
	CK 小黑菌核病	32.0			
	小黑菌核病	14.0	402.5	385.0	17.5
臺農糯8號	紋枯病	35.9	382.5	355.0	27.5
	CK 紋枯病	47.7	400.0	372.5	30.5
	CK 小黑菌核病	56.0			
	小黑菌核病	20.5	345.0	325.0	20.0
臺農38號	紋枯病	31.5	345.0	322.5	22.5
	CK 紋枯病	22.6	360.0	329.5	30.5
	CK 小黑菌核病	23.0			
	小黑菌核病	14.5	397.5	372.5	25.0
白米粉	紋枯病	10.7	222.5	202.5	20.0
	CK 紋枯病	33.3	255.0	235.0	20.0
	CK 小黑菌核病	16.0			
	小黑菌核病	1.5	257.5	235.0	22.5

據表二，三表示，本試驗稻品種中對紋枯病及小黑菌核病之感病程度均高，難以認出極抗病之品種，據横木氏[13] (1933) 在觀察品種與發病之關係時，認爲分蘖數多之品種發病較多，岩田[3] (1956)報告稻品種對紋枯病之關係，認爲施用氮肥或播種期提早時最易發病，但品種間之被害序列難以決定。

3. 稻小黑菌核病被害莖內之菌核數量與其分佈調查

本調查供試之病害標本係於48年11月20日採自同年度第二期作，臺北市本所稻作試驗田之光復1號。其發病狀況甚嚴重者，病莖之內部崩壞而且倒伏。標本採集後放於室內陰乾後於12月8日調查觀察。調查方法爲隨機採集20株，每株再隨機採2莖計40莖，調查方法乃將稻莖之最下端部開始，每2公分切爲若干段，觀察該2公分內之桿及葉鞘內所形成之菌核數，本次調查結果1莖內菌核數量最多者達3,152個，最少者亦達395個，但自莖之下端2公分就有菌核之形成，漸向上方遞增菌核數量，在 6~8 公分之間達最高峯，再上方卽隨之減少菌核數量。自16公分以上時有的莖內均無形成。不過本觀察僅一次，可能因稻品種或年次其菌核形成數量有異，須等待今後之繼續檢討。茲列本項觀察結果之平均價於表四。

表四：稻小黑菌核病被害莖內之菌核數量與分佈

稻莖基端向上之間階距離	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	計
各2公分內之菌核數	173	264	283	206	143	132	106	99	76	59	48	41	30	12	5	1,677

據表四可知在稻株莖之下部 4–8 公分內之菌核數最多，本省一般農家於刈稻時留在土面上之稻莖都在10公分以上，如按上列之數字估計則每一遺留之稻莖留在土面上之菌核約有1,000個以上。因本病原菌均在葉鞘或稈內面形成菌核，故防除方法在尚未確定之前應注意常被害田裏的稻稈處理。

三、摘　　要

在本省稻之菌核性病害其爲害不亞於稻熱病，尤於第二期作之爲害爲最嚴重，故數年來對本病舉行若干之調查，其結果錄如下：

1. 供試稻品種中多數稻種對於紋枯病之被害莖率，因氮肥施用量增加，而其被害率亦隨之增加。故稻之生育狀況卽稻株高及穗數雖隨氮肥之增加而其生育較佳，不過產量當一般氮肥施用量多

時反而影響其產量。

2. 於田間舉行人工接種稻紋枯病菌 (Corticium Sasakii (Shirai) Matsu. = Pellicularia Sasakii (Shirai) Ito) 及小黑菌核病菌 (Helminthosporiun Sigmaideum Cav. var. irregirlar Crelley et Tullis.) 觀察蓬萊稻之感病程度，對該二種病害之感病程度均相當高，難以認出抗病性較强之品種。

3. 觀察稻小黑菌核病被害莖內之菌核數量與其分佈狀況，在被害莖之30公分高還可檢出菌核之存在，菌核最多處在莖的 4~8 公分之間。供試稻藁平均每莖內之菌核有 1,677 個之多，在防除病害在尚未確定之前須注目此點。

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STUDIES ON THE SCLEROTIAL DISEASES OF RICE PLANT IN TAIWAN

I Relation of Fertilization and Rice Varieties to an Outbreak of the Sclerotial Diseases

by

C. C. CHEN, C. C. CHIEN & T. F. HWANG

Summary

The Sclerotial diseases are the potential menace to the rice plants grown in the 2nd crops season, and together with the rice blast whose outbreak is mostly confined to the lst crop season, constituting the major fungous diseases of the rice plants occurring in Taiwan. This report deals with the observations which have been made during the past years on the effect of fertilization and rice varieties to the development of the diseases in question.

1. Most of the varieties so far examined revealed that percentage of the affected culms caused by *Corticium Sasakii* was somewhat proportional to an increase in amounts of the nitrogenous fertilizer applied. However, growth conditions of the rice in terms of height and numbers of ears are generally stimulated at high nitrogenous levels, while the yield was appreciably hampered by an excessive application of N fertilizer.

2. Pon-lai varieties which are subjected to the artificial inoculations made in the field with two pathogens, viz., *Corticum Sasakii* (*Shirai*) *Matsu.* and *Helminthosporium sigmoideam Cav. var. irregulare Crelley et Tullis,* showed remarkably high degrees of susceptibility and it as rather difficult to find out the resistant varieties, so far as the present experiments are concerned.

3. Observations on the number and distribution of the sclerotia of *Helminthosporium sigmoideam var. irregulare* within the diseased culms are also made. A great majority of sclerotia formed are confined to the height of 4–8 cm., though the presence of Sclerotia is still noticeable as high as 30 cm. from the soil level. An average number of sclerotia per each diseased culm is as much as 1,677.

FIELD TESTS WITH THIMET ON COTTON INSECT CONTROL IN TAIWAN[1]

by

Y. P. TSAI & C. H. YOU*

Previous experiments conducted in 1959 in Tainan Fiber Crops Experiment Station by Tsai and You[20] showed the effectiveness of systemic insectictde Thimet for the control of leafhopper, aphid and spider mite on cotton seedling stage. The further study of Thimet on control of early season cotton insects, particularly the leafhopper, *Chlerita biguttula Ishida*, and aphid, *Aphis gossypii Glover*, fiield experiments were carried out during 1960 in Tainan Fiber Crops Experiment Station, Taiwan Agricultural Research Institute, Taiwan, Republic of China.

MATERIALS AND METHODS

Experiment 1

The purpose of this experiment was to determine the suitable place of Thimet on furrow treatment. The variety of Empire cotton fuzzy seed was used. One gram of 10% Thimet granules at the rate of two pounds of toxicant per acre was put three different places, i.e., one cm. under the seed, under the seed that contact with seed and 3 cm. aside the seed. The cotton seeds planted by hand on May 16, 1960. The plots were one row wide and five meters length. One line arrangement was replicated four times.

Experiment 2

Furrow treatments were made of 10% Thimet granules at the rate of 1 and 2 pounds of toxicant per acre by hand at the time of planting. The variety of Empire cotton fuzzy seed was planted on June 22, 1960. Side dressing treatment were made of 10% Thimet granules at the rate of 2 and 4 pounds of toxicant per acre by hand after 42 days (Aug. 3) planting under high soil moisture condition. Side dressing trearment was added at the rate of 4 pounds of toxicant per acre by hand after 73 days (Sep. 3) planting on the plot of 1 lb. Thimet furrow treatment for control of mid-and lateseason cotton insects. The plots were nine row wide (9 meters) and eight meters length. A randomized block design was replicated four times.

RESULTS

Experiment 1

The result of this experiment are shown in table 1. The germination of cotton

1. This work was supported by a grant from American Cyanamid Company.

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was decreased by the treatment of Thimet which place one cm. under the seed or contact with the seed. Plant height of check plots were lower than Thimet treated, because of leaf curl and retarding growth that caused by the attack of leafhopper and aphid. The square count of check plot were less than the Thimet treated plot that was caused by the retarding of plant growth. The population of early-season cotton insects as leafhopper, aphid and spider mite were relatively low during June and July. All Thimet treated plots controled early-season cotton insects effectively. There were no significant difference on insect control effect between three methods of different Thimet places. According to the percentage of insect infestation on square, Thimet has no control effect on the major mid-and late-season cotton insects, i.e., pink bollworm, *Pectinophora gossypiella Saunders* and spotted bollworm, *Earias fabia Stoll.*

Experiment 2

The result of this experiment are shown in table 2. Thimet furrow treatment control leafhopper significantly during 53 days after planting, and aphid during 72 days. Thimet side dressing treated 42 days after planting gave good leafhopper and aphid control effect during 49 days after treatment, and it elongated about 80 days length. High dosages of each treatment showed relatively good control effect. Addition of side dressing treatment on Sep. 3 to the furrow treatment plot, it gave good control effect on leafhopper and aphid, and decreased the population of above two insects on Sep. 10. In this experiment, outbreak of pink bollworm on squares, flowers and bolls were relatlvery lower than spotted bollworm. Thimet has no control effect on pink bollworm and spotted bollworm. The number of squares, flowers and bolls of check plot were less than Thimet treated plot, because of abnormal cotton plant growth that caused by severe leafhopper attacking. The seedcotton yield of side dressing treatment at the rate of 4 pounds Thimet per acre followed by furrow treatment with 1 pound Thimet per acre was highest than other treatment, it was 53 per cent over check.

Table 1. Effectiveness of Thimet furrow treatment with three different place on cotton insects control

Date of examination	Days during planting and examination	Untreated check	Place of one gram 10% Thimet granules		
			3 cm. aside the seed	1 cm. under the seed	under the seed contact with seed
		Percentage of germination			
		63	62	55	43
		Leafhopper infestation (Number per plant)			
June 3	18	1.09	0	0	0
June 14	29	1.73	0.05	0.06	0.13
		Leafhopper infestation (Number per leaf)			
June 18	33	0.90	0.02	0	0
July 1	46	2.23	0.13	0.08	0.23
		Aphid infestation (Number per plant)			
June 3	18	5.78	0.42	0.02	0
June 14	29	0.93	0	0.03	0.03
		Aphid infestation (Number per leaf)			

June 18	33	5.30	0	0	0
July 1	46	0	0	0	0
		Spider mite infestation (Number per plant)			
June 13	18	0.27	0	0	0
June 14	29	0	0	0	0
June 18	33	0	0	0	0
July 1	46	0	0	0	0
		Plant height (cm.)			
July 1	46	21.0	32.0	30.7	31.3
July 23	68	26.3	40.8	42.2	41.1
		Percentage of Pink Bollworm infestation on squares			
July 23	68	6.3	13.7	8.2	10.4
		Percentage of Spotted Bollworm infestation on squares			
July 23	68	11	37	20	21
		Square count (Number per 20 plants)			
July 11	56	84	152	126	166
July 23	68	16	117	110	77

Table 2. Effectiveness of furrow and side dressing treatment with Thimet on cotton insects control

Date of examination	Days during planting and examination	Untreated check	Furrow treatments with Thimet granules*		Side dressing treatment with Thimet granules*	
			1	2	2	4
		Leafhopper infestation (Numbers per 80 leaves)				
July 26	34	344	18	14	361	325
Aug. 7	46	174	36	2	22	30
Aug. 14	53	265	68	34	0	8
Aug. 22	61	451	235	136	12	8
Sep. 2	72	458	300	330	17	2
Sep. 10	80	139	25	156	4	5
Sep. 21	91	473	4	230	50	19
		Aphid infestation (Numbers per 80 leaves)				
Aug. 14	53	3	3	2	2	1
Sep. 2	72	18	4	5	0	0
Sep. 10	80	106	5	59	0	0
Sep. 21	91	182	12	83	31	1
		Percentage of Pink Bollworm infestation on square of fourty plants				
Sep. 13	83	5.03	7.95	12.09	9.84	8.21
Oct. 3	103	23.68	9.55	7.91	8.25	8.70
Oct. 24	124	23.08	2.50	12.96	4.36	3.60
Nov. 9	140	7.69	4.58	6.90	0	0
		Percentage of Pink Bollworm infestation on bloom of fourty plants				
Sep. 13	83	0	3.33	4.00	4.35	3.01
Oct. 3	103	7.32	5.00	3.50	12.00	9.09
Oct. 24	124	2.53	1.96	5.56	1.40	6.78
Nov. 9	140	0	3.70	8.33	0	0
		Percentage of Pink Bollworm infestation on boll of fourty plants				
Sep. 13	83	2.66	0.22	2.22	1.55	0.93
Oct. 3	103	7.94	6.14	3.39	8.78	7.62
Oct, 24	124	4.00	13.69	7.68	8.15	14.81
Nov. 9	140	2.49	3.94	5.14	5.26	4.64
		Percentage of Spotted Bollworm infestation on square of fourty plants				
Sep. 13	83	0	0.66	1.10	0	1.03
Oct. 3	103	11.40	14.65	11.86	13.59	15.19
Oct. 24	124	35.16	18.57	36.11	17.45	20.14
Nov. 9	140	53.85	58.78	65.52	44.44	49.48
		Percentage of Spotted Bollworm infestation on bloom of fourty plants				
Sep. 13	83	0	16'66	0	0	0
Oct. 3	103	4.88	15.00	14.04	6.67	9.09
Oct. 24	124	10.13	13.73	16.67	8.45	13.56
Nov. 9	140	21.43	55.56	25.00	50.00	23.07
		Percentage of Spotted Bollworm infestation on boll of fourty plants				
Sep. 13	83	1.18	0	1.23	1.24	0.93
Oct. 3	103	6.35	7.60	9.92	22.04	15.02
Oct. 24	124	11.20	13.06	12.46	7.07	16.67
Nov. 9	140	39.83	32.78	36.25	30.26	35.54
		Square count (Numbers of fourty plants)				
Sep. 2	72	430	562	394	332	328
Sep. 13	83	139	151	182	244	195

Oct. 3	103	114	314	253	412	540
Oct. 24	124	91	280	108	275	417
Nov. 9	140	26	131	29	81	97
		Bloom count (Numbers of fourty plants)				
Sep. 2	72	30	30	28	22	26
Sep. 13	83	15	30	25	23	33
Oct. 3	103	41	60	57	75	121
Oct. 24	124	79	51	36	71	59
Nov. 9	140	14	27	12	6	13
		Boll count (Numbers of fourty plants)				
Sep. 2	72	100	112	106	120	124
Sep. 13	83	338	456	406	322	324
Oct. 3	103	252	342	383	245	433
Oct. 24**	124	250	314	313	368	378
Oct. 24***	124	208	82	146	123	152
Nov. 9****	140	241	482	331	380	453
		Seedcotton yield (kilograms per hectare)				
Seedcotton yield		580.5	886.4	795.8	725·0	811.3
Index		100	153	137	125	140
Gain over check		—	305.9	215.3	145.0	230.8

L. S. D. 5%=3.26, 1%=5.41

* All dosages in actual pounds per acre
** Unmature boll
*** Dry harvested boll
**** Numbers of bolls except dry harvested boll

DISCUSSION AND CONCLUSION

Thimet was used on cotton insect control firstly by Ivy, Scales and Gorizychi [11] at Texas in 1954. Reports about practical application of Thimet were written by many workers on various crops. Thimet gave effective control on; thrips[1,7,11,15,16,17,19,20], aphid[1,6,9,10,11,15,16,17,19,20], spider mite[11,15,20] and overwintered boll weevil[11,15,16,17] of cotton.

In Taiwan, most severe early-season cotton insects are leafhopper and aphid. According the results of these experiment, Thimet applied at the dosages of 1 and 2 pounds per acre as a furrow treatment significantly decreased the number of leafhopper for 53 days, and aphid for 72 days. Thimet applied at 2 and 4 pounds per acre as a side dressing treatment after 42 days planting decreased the population of leafhopper and aphid for 49 days and as long as 80 days after treatment. Hopkins, Fye and Walker[10] reported that Thimet applied at 10, 20 and 30 pounds per acre as a side dressig significantly decreased the numbers of cotton aphid for 15 months, and seed or further treatments with 1 to 3 pounds per acre at time of planting significantly reduced aphid populations for one growing season. Adkinsson[1] and Hopkins, Fye and Walker[9] reported that Thimet gave aphid control until late in the season. Most severe insects in the mid- or late-season cotton in Taiwan are pink bollworm, spotted bollworm and bollworm (*Heliothis armigera*). Thimet has no control effect for pink bollworm and spotted bollworm according to the result of these experiments. Bollworm was not discovered on these experiments. Thimet had no effective control for bollworm[11] or increase bollworm infestation(15). Because of relatively low population of insects in the cotton seedling stage in Taiwan, the side dressing at the time of first fertillization 3 to 6 weeks after the date of planting may more economical than seed treatment or furrow treatment and increase the period of plant pretection. It is considerable that Thimet may be use for early or mid-season cotton insect control in

Taiwan, and can save 2 to 3 times of chemical spray for leafhopper and aphid control. But in the area that pink bollworm or spotted bollwerm is the problem of early-, or mid- season cotton growing, for using of Thimet is hopeless.

When Thimet granular are placed contact with cotton seed or one cm. under the seed, it decreased the percentage of cotton germination, but there were no significant negative growth of delayed fruiting of cotton. Thimet may delayed fruiting of cotton[4,15] and adverse effects upon the germination[15] and negatable growth of cotton[4,15]. Seed treatments of Thimet adversely affected stands, but in furrow treatment did not[9]. Parencia, Davis and Cowan[18] noted that under dry and cool or better moisture condition, Thimet had no influence to germination and stand. Reynolds etc.[19] reported that many cotyledons of newly emerged ctton, alfalfa and sugar beet plants showed some burns on the outer margins with Thimet treatment. It was more pronounced at the higher rates, but did not appear in the leaves. Seedling cotton plants show some reduction in size but this difference disappeares in about 2 to 3 weeks. Tsai and You[20] described that Thimet treated cotton seed produce small size of cotyledon. High Thimet dosages may cause necrotic flecking of the leaves [5,11].

Thimet-fertilizer mixtures did not cause any apparent phytotoxicity to the three grain crops[12]. Various soil phosphate level had no measurable effect on the uptake of the texicant[10], It was no evidence that Thimet was taken up or tranaslocated more readily in soils with a lower level of phosphorus[9]. Thimet may absorbed very quickly from soil under high soil moisture condition. It decreased the population of leafhopper and aphid significanlly 4 days after side dressing in our experiment (Exp. 2).

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SUMMARY

These experiments were carried out during 1960 in Tainan Fiber Crops Experiment Station, Taiwan Agricultural Research Institute, Taiwan, Republic of China. Ten per cent Thimet granules was applied by in-furrow at the rate of 1 (A treatment) and 2 (B treatment) of toxicant per acre and side dressing at the rate of 2 (C treatment) and 4 pounds (D treatment) of toxicant per acre after 42 days planting. Side dressing treatment was added at the rate of 4 pounds of toxicant per acre after 73 days planting on the plot of A treatment.

Thimet furrow treatment controled leafhopper significanlly during 53 days and aphid during 72 days. Thiment side dressing treatment gave good leafhopper and aphid control during 49 days and it elongated about 80 days length. Thimet treatment gave no control effect on pink bollworm and spotted bollworm.

The range ef yield was A>D>B>C>CK, its yield per hectare were 886.4, 811.3, 795.8, 725.0 and 580.5 kg. resp., and its index were 153, 140, 137, 125 and 100 resp.

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棉作害蟲防治 Thimet 田間試驗

蔡 雲 鵬　　游 江 海

摘　　要

本試驗于1960年間，於臺南棉麻試驗分所農場舉行。使用10% Thimet 粒劑，計分 4 種處理。即在播種棉籽時，于棉籽旁每英畝使用 Thimet (以 Technical 計算) 1 磅(A處理)及 2 磅 (B處理)，另於播種棉籽後42天于棉株旁每英畝條施 Thimet 2 磅(C處理)及 4 磅(D處理)。A處理在播種後73天，另條施每英畝 Thimet 4 磅。

A及B處理，經施用 Thimet 後53天，對棉浮塵子防治有顯著之效果，對棉蚜蟲防治則有72天之效果。C及D處理，對棉浮塵子及棉蚜蟲之防治有效期間，有49～80天之久。對主要棉鈴害蟲，大紅鈴蟲及綠帶金鋼鑽，各處理均無防治效果。各處理之籽棉產量高低順序爲 A>D>B>C> 對照區(CK)，其產量每公頃爲 886.4, 811.3, 795.8, 725.0 及 580.5 公斤，產量指數各爲 153: 140: 137: 125: 100。

將 1 公分量之10% Thimet 粒劑置於棉籽下部 1 公分處，或與棉籽接觸時，顯著的減少棉籽發芽率。如置於棉籽旁邊 3 公分處，則無任何葯害現象。

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